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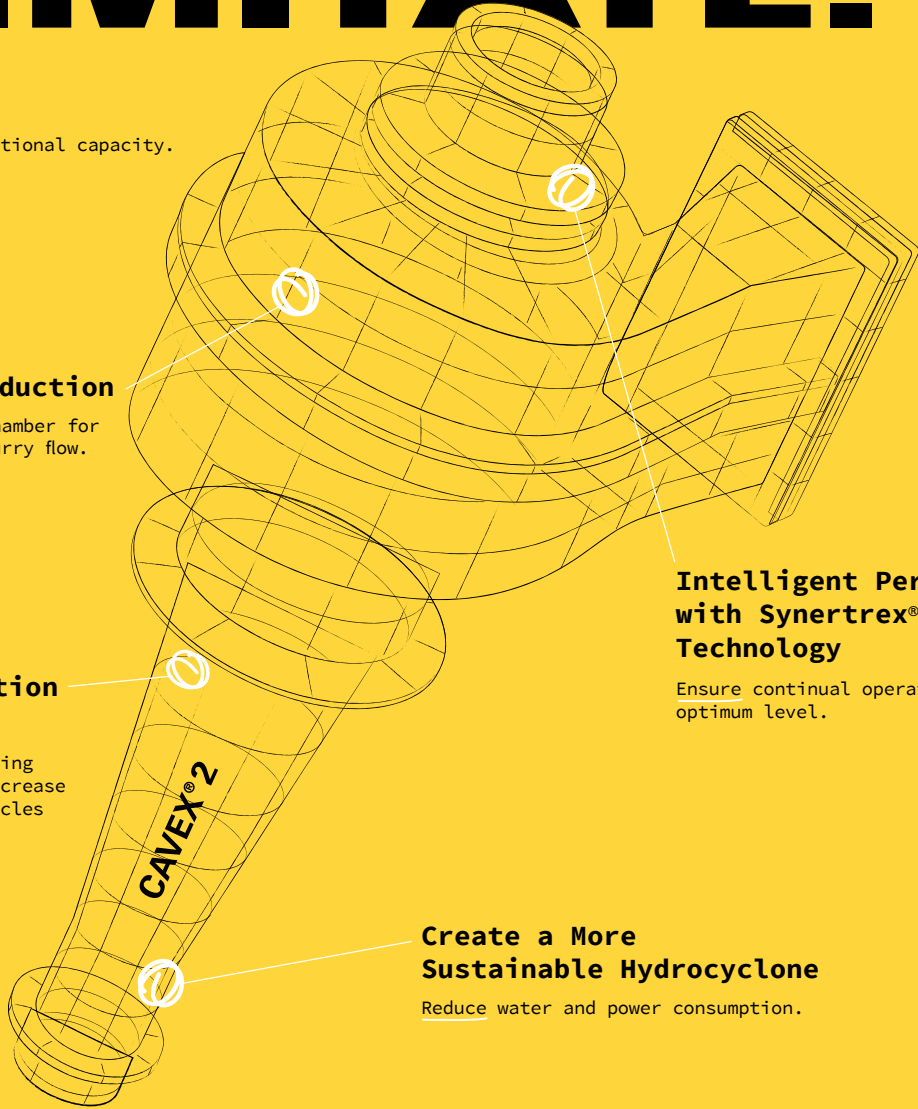
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FEATURES

- Tailings Engineers Wanted...**
Seven experts discuss how the mining industry can recruit, train and retain the tailings engineers it so desperately needs..... **22**
- This Year's Iron Ore Report Looks Much Better Than Many Expected**
High prices and a tight market could extend the rally well into 2022 **28**
- Drilling Trends Demand Tougher Bits**
Suppliers are building more powerful rigs. Customers want more drillhole footage. The industry is moving toward autonomous drilling. Can new rock tools meet these challenges? **34**
- Slope Monitoring Tech Trends Spread Safety**
Increasing integration and ease-of-use define the latest slope stability solutions, making them easier and potentially cheaper to adopt..... **40**

LEADING DEVELOPMENTS

- Freeport Reports Higher Q3 Copper Sales Volumes..... **4**
- K+S Sells Americas Salt Business to Stone Canyon..... **4**
- Sumitomo Sells Ownership in PT Vale; Considers Options for Sierra Gorda..... **4**
- Argonaut Gold Approves Magino Project Construction..... **5**
- Saracen Minerals Will Merge With Northern Star Resources..... **5**

AROUND THE WORLD

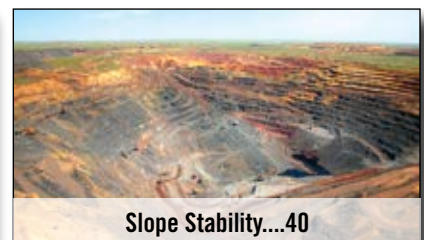
- U.S. & Canada:** Runaway Skip Damages Triple 7 Operations in Manitoba..... **6**
- Australia/Oceania:** Argyle Diamond Mine Operations Wind Down..... **12**
- Latin America:** Minera Alamos Will Speed Up Cerro de Oro Development..... **14**
- Asia:** Polyus Reports Maiden Reserve Estimate for Sukhoi Log Gold Project..... **16**
- Africa:** Recurring Theme of Optimism at Annual Jo'burg Indaba Symposium..... **18**



This month, E&MJ provides an in-depth report on the tools being used to evaluate pit wall stability. On the cover, managers discuss the pit walls at the El Soldado mine in Chile. (Photo: Anglo American)

DEPARTMENTS

- Calendar..... **21**
- Classified Advertisements..... **62**
- Equipment Gallery..... **58**
- From the Editor..... **2**
- Letter to the Editor..... **17**
- Markets..... **64**
- Operating Strategies..... **46**
- People..... **10**
- Processing Solutions..... **54**
- Suppliers Report..... **48**
- This Month in Coal..... **20**





Steve Fiscor
Publisher & Editor-in-Chief

Always Consider the Source

We often joke that trade journals like *Engineering & Mining Journal* (*E&MJ*) are the antidote for “fake news,” but it’s true. Most engineers are problem solvers and they have been trained to think critically. We evaluate the problem rationally and analyze the facts and try to make an objective decision. Our right-brained friends often consider us to be skeptical and annoyingly logical. Using data, models and critical paths, a good engineer can tell management when, why and how with a fairly high level of precision.

Usually engineers can apply those same inherent traits outside their work life with a great deal of success. What would happen if you found the cards were stacked against you? What if you found that some of the information you were being fed was fictitious? What would you think if you, your friends and your family were being played? It’s happening, it’s unfair and it’s kind of scary.

A new docudrama, *The Social Dilemma*, is being distributed on Netflix. It details the dark side of social media and it shines a light on some of the damaging effects it is having on society. The film contains firsthand interviews with former executives from the tech industry who talk about how the platforms have been designed to entice use to the point of addiction, the negative impact it’s having on mental health, and the role it plays in spreading conspiracy theories. They explain how the big tech firms are gaining financially through data mining and surveillance capitalism. Throughout the piece, the executives say this was not their intention when they built these platforms.

One of the problems is that people naturally gravitate toward news sources that tell them what they want to hear. It doesn’t help that most sources today have become biased. The algorithms detect this and feed similar information to the user’s devices. The boomers are somewhat immune to this as the social media adoption levels are not as intense, but Generations X, Y and Z are highly engaged. Our youngest generation will grow up with these platforms from adolescence onward.

The use of social media will continue to grow and the best way to solve this problem is to educate those around us. As leaders, we need to set examples with constructive dialog and, if needed, step up and diffuse the situation. Already, we see users policing LinkedIn groups, telling other users to take down their biased or explicit content. Social media users should always investigate the source.

We believe we can use our social media platforms for good. *E&MJ*’s followers on LinkedIn, Facebook and Twitter have grown substantially in the last few years. As the leading publisher of mining trade journals, we promise to do our part, too. Over the years, we have earned your respect as a trustworthy source. We will strive to deliver the most useful information objectively. Enjoy this edition of *E&MJ*.

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Freeport Reports Higher Q3 Copper Sales Volumes



Freeport's quarterly copper and gold sales were higher than expected, but not as high as the same period in 2019.

Freeport-McMoRan reported third-quarter 2020 copper sales of 848 million lb, which were 7% higher than the July estimate of 790 million lb of copper. This was due to higher sales from North American and South American mines. Third-quarter 2020 copper sales were higher than third-quarter 2019 sales volumes of 795 million lb of copper, primarily reflecting higher copper ore grades in Indonesia, partly offset by lower sales from North America and South America as a result of lower mining rates associated with the April 2020 revised operating plans, according to the company.

"Our seasoned, motivated and value-focused global organization delivered strong results during the third quarter and continues to demonstrate the 'Freeport Edge,' President and CEO Richard C. Adkerson said. "Our team is protecting the health of our workforce and communities where we operate as a first priority, as we serve customers, operate efficiently and advance significant growth in production."

He added that strong cash flows, growing volumes, effective cost management and positive market outlook

will provide "momentum to continue to strengthen our balance sheet, increase returns to shareholders and generate long-term values for all stakeholders."

Third-quarter 2020 gold sales of 234,000 ounces (oz) were 6% higher than the July estimate of 220,000 oz of gold, primarily reflecting higher ore grades in Indonesia. Third-quarter 2020 gold sales were lower than third-quarter 2019 sales volumes of 243,000 oz of gold, primarily reflecting lower mining and milling rates associated with the ramp-up of underground mining at PT Freeport Indonesia (PT-FI), partly offset by timing of shipments in third-quarter 2019.

Third-quarter 2020 molybdenum sales of 20 million lb were higher than the July estimate of 18 million lb, but were lower than third-quarter 2019 sales of 22 million lb.

Consolidated sales volumes for 2020 are expected to be 3.18 billion lb of copper, 800,000 oz of gold and 80 million lb of molybdenum. Metal production is expected to improve significantly in 2021 with estimated consolidated sales of 3.85 billion lb of copper and 1.4 million oz of gold, according to the company.

K+S Sells Americas Salt Business to Stone Canyon

K+S AG signed a contract to sell its Americas salt business bundled together as the Americas Operating Unit to Stone Canyon Industries Holdings LLC (SCIH), Mark Demetree and affiliates. The sales price amounts to \$3.2 billion and represents 12.5 times the 2019 EBITDA of \$257 million, according to the company. The closing of the transaction is expected to occur in summer 2021, subject to customary closing conditions, including approvals from regulatory authorities.

"With the sale of our Americas salt business, we are taking a giant step in reducing debt," Chairman Dr. Burkhard Lohr said. "We are thus creating a solid financial basis for the sustainable development of the company."

The Americas operating unit mainly comprises K+S Chile, formerly known as the Chilean company SPL, acquired in 2006, as well as Morton Salt (USA) and K+S Windsor Salt (Canada), acquired in 2009.

"With its iconic Morton Salt brand and other industry leading products and solutions, the combination of the Americas salt business with SCIH's Kissner Group Holdings allows us to expand our product offerings to consumers along with our existing government and commercial customers," SCIH Co-CEO James Fordyce said. "The Americas salt business adds an integral component to SCIH's long-term, growth-oriented business model."

As expected, the high level of interest in the attractive Americas salt business resulted in a generally rapid negotiation process and led to the signing of the agreement in the current financial year as anticipated, the company said.

Sumitomo Sells Ownership in PT Vale; Considers Options for Sierra Gorda

Sumitomo Metal Mining Co. Ltd. (SMM) has agreed to sell off a portion of the shares it held in the Repub-

lic of Indonesia's PT Vale Indonesia Tbk (PTVI), along with its holding in Vale Canada Ltd. (VCL) to the Republic of Indonesia's PT Indonesia Asahan Aluminium (Persero). The company entered into the stock purchase and sale agreement on June 19, and the sale and transfer was completed on October 7.

VCL and SMM completed the sale and transfer of an aggregate of 20% of their shareholding in PTVI to the buyer nominated by the Government of the Republic of Indonesia, Perseo. Upon completion of the transaction, VCL will hold 44.3% shares and SMM will hold 15% shares in PTVI, or a total of 59.3% shares.

In October 2014, PTVI agreed to revise the mining business contract it entered in 1996 with the Indonesian government, which will expire in December 2025. PTVI must obtain permission to conduct mining activities to continue to operate after 2025. One of the requirements is that 40% of the investments into PTVI be with Indonesian capital, and this transaction satisfies that requirement.

The amount transferred was approximately 9.9 billion yen (\$95 million), and the company estimates that the overall effect on business results will be minor.

SMM and Sumitomo Corp. said that they were also reviewing their options regarding the Sierra Gorda mine in Chile's Antofagasta region, including a potential sale of their ownership interests. Sierra Gorda is jointly owned by SMM, Sumitomo Corp. and KGHM Polska Miedź SA. A large, open-pit copper mine, Sierra Gorda mines and processes 110,000 metric tons (mt) per day. During the first half of 2020, it produces 71,000 mt of copper, which compare to 53,000 mt of copper in H1 2019.

Argonaut Gold Approves Magino Project Construction

Argonaut Gold Inc. has approved the construction of the company's 100% owned Magino gold project in Ontario, Canada. Argonaut also received a fixed bid pricing proposal for a significant portion of the initial capital requirement for the project and has secured debt financing of up to \$175 mil-

lion by way of a \$500 million bought deal offering of senior unsecured convertible debentures and the extension and expansion of its existing revolving credit facility (RCF) for up to \$125 million.

Argonaut said it anticipates a two-year construction period beginning in January 2021 following the closure plan filing and posting of a financial assurance bond with the province of Ontario. The first gold pour is anticipated during the first half of 2023.

In the Magino Feasibility Study Technical Report filed December 2017, initial capital was estimated at \$321 million and has recently been esti-

mated at between \$360 million and \$360 million, including contingency and inflation.

The company has recently received a fixed bid pricing proposal that covers approximately 50% of the recent initial capital estimate of between \$360 million and \$380 million.

The Magino FS demonstrated that the Magino project is a strategic, scalable, long-life asset in the attractive mining jurisdiction of Ontario, Canada. It will be a 10,000-metric-ton-per-day processing facility and average annual gold production of 150,000 ounces over the first five years with a mine life of 17 years.

Saracen Minerals Will Merge With Northern Star Resources

Northern Star Resources Ltd. and Saracen Mineral Holdings Ltd. have agreed to a merger. Northern Star will acquire 100% of the shares in Saracen. Saracen shareholders will receive 0.3763 Northern Star shares for each Saracen share held. Saracen will also pay a special, fully franked dividend of A3.8¢ per Saracen share. Upon completion of the transaction, Northern Star will own 64% of the combined company, and Saracen will hold the remaining 36%.

The companies said the merger will create a top 10 global major gold producer, with high-margin assets located exclusively in Tier-1 jurisdictions. Saracen has three operations within 300 kilometers (km) of Kalgoorlie: Carosue Dam, Thunderbox and 50% of the Super Pit.

Production is slated to grow from more than 500,000 ounces (oz) in the current financial year to more than 600,000 oz in the following year. Northern Star operates three concentrated centers: Jundee; Kalgoorlie including Kanowna Belle, Kundana (the East Kundana Joint Venture), South Kalgoorlie and KCGM (joint venture); and the Pogo operations in Alaska.

Both the Saracen and Northern Star boards have unanimously recommended the merger.

Under the agreement, Northern Star Executive Chair Bill Beament will be the chair of the merged group, transitioning from executive to non-execu-

tive chair in July 2021. Saracen Managing Director Raleigh Finlayson will be managing director. Stuart Tonkin will be chief executive officer and Morgan Ball will be chief financial officer. Upon completion, the board of nine will comprise of five Directors from Northern Star and four directors from Saracen. Saracen Non-executive Chair Tony Kieran will be the lead independent non-executive director.

"Northern Star has only ever pursued growth when it will create value for shareholders, and this merger of equals will create an abundance of value for both Northern Star and Saracen shareholders," Beament said. "This is significant value-creating M&A (merger and acquisition)."

Pretax synergies are expected to be worth A\$1.5 billion to A\$2 billion over the next 10 years, according to Finlayson.

"This is one of the most logical and strategic M&A transactions the mining industry has seen," Finlayson said. "The savings, the synergies and the growth opportunities it will generate make the transaction extremely compelling."

The merger will create a combined portfolio of high-quality assets concentrated in three logical production centers exclusively in Tier-1 jurisdictions and a presence in the West Australian Goldfields, with the transaction consolidating KCGM — the iconic "Golden Mile" — under single ownership for the first time in its more than 125-year history.

Runaway Skip Damages Triple 7 Operations in Manitoba



Hudbay restarts production using ramp haulage.

Hudbay Minerals Inc. has completed a preliminary inspection at its 777 Mine in Flin Flon, Manitoba. During mid-October, the company suspended production at the mine after a hoist rope detached from a skip, causing the skip to fall to the bottom of the shaft. There were no injuries and all underground personnel were safely evacuated from the mine using the secondary ramp access.

A preliminary video inspection of the mine shaft indicated that the damage is limited to the headframe and the bottom of the shaft in the skip compartment. It also does not appear that the cage compartments or the ore loading area were damaged, and the structural integrity of the shaft does not appear to have been compromised by the incident, according to the company.

A full inspection of the shaft and skip compartment will require an in-person inspection, which Hudbay said is expected in early November.

Underground mining activity has resumed at 777 with limited production from the mine's ramp access. If there is no further damage beyond what has been identified, Hudbay said the 777 shaft could resume full production in December at a repair cost that is not expected to exceed \$5 million.

While fourth quarter production and sales volumes will be impacted, the company said it is implementing production mitigation plans and expects the Manitoba business unit to achieve its full-year production and unit cost guidance for 2020.

Bullfrog Gold Signs Agreement With Barrick, Augusta

Bullfrog Gold Corp. has entered into definitive agreements with Barrick Gold Corp. subsidiaries and Augusta Investments Inc. where Bullfrog will acquire rights to 1,500 acres adjoining the company's Bullfrog Gold Deposit from Barrick. Augusta and certain individuals identified by Augusta will concurrently complete a C\$22 million investment in Bullfrog.

"We are delighted to announce the signing of the definitive agreements and are encouraged by the positive market reaction to the announcement of the binding term sheet in respect of the transaction," Bullfrog CEO and President David Beling said. "Bullfrog will be well-funded to expedite the exploration and development of the Bullfrog project, and we are excited to welcome our new cornerstone shareholders, Barrick and Augusta."

Bullfrog Gold Corp. is a U.S.-based gold and silver exploration company with a commanding land and mineral position in the

Bullfrog mine area 4 miles west of Beatty, Nevada. The Bullfrog Gold Project is located in the Walker Trend about 120 miles NW of Las Vegas and has access to infrastructure. Barrick Gold produced 2.1 million ounces of gold during the 1990's from the main Bullfrog open pit, the northern one third of which is controlled by Bullfrog.

Upon completion of the transaction, Barrick and Augusta will become significant shareholders in Bullfrog. Additionally, the board of directors and management of the company will be reconstituted upon closing such that Maryse Bélanger will be appointed president, CEO and director of the company along with the appointment of Donald Taylor, Daniel Earle and a Barrick nominee to the company's board of directors. David Beling will remain on the board.

The mineral lease and option to purchase agreement between a subsidiary of BFGC and Barrick dated March 23, 2015, has been terminated and the Barrick back-in right has been eliminated. A 2% net smelter return (NSR) royalty granted to Barrick also decreases to a minimum 0.5% NSR royalty on certain Barrick lands already subject to royalties.

The transaction is expected to close during the fourth quarter of 2020.

Ascot Orders Equipment for Premier Gold Mine

Ascot Resources Ltd. signed an agreement for the delivery of a semi-autogenous grinding (SAG) mill and a ball mill, which are the long lead items required for the concentrator refurbishment at Premier gold mine in British Columbia's Golden Triangle. Montreal-based Farnell-Thompson Applied Technologies (Farnell-Thompson) will deliver the SAG and ball mills and related equipment. Farnell-Thompson is a leader in heavy machinery engineering design with significant experience in the design and delivery of grinding mills, according to the company.

"The Ascot team has worked diligently over the summer to complete all of the engineering work to put us in a position to place the order for the SAG and ball mills," Ascot President and CEO Derek

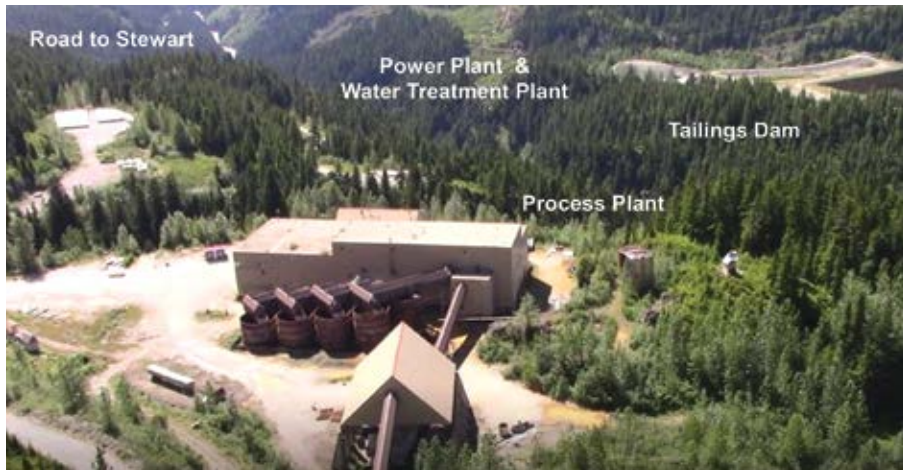


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With the help of Farnell-Thompson, Ascot Resources is refurbishing the Premier gold mill (above), near Stewart, B.C.

White said. "This equipment is critical to our construction timeframe and having the support and expertise of Farnell-Thompson and Ascot's in-house engineering team has helped the company continue along its path toward production."

The order comprises a 22-ft diameter by 8-ft effective grinding length SAG mill and 14.5-ft diameter by 19.5-ft effective grinding length ball mill. Both mills will be driven by 2,000 KW, low speed synchronous motors at 78% critical speed, the company said. The mills will be supported on 90-in. diameter hydrodynamic trunnion bearings, which will be interchangeable. The mill lube systems will be identical for both mills.

Agnico Eagle Invests in Maple Gold Mines

Agnico Eagle Mines Ltd. has agreed to purchase 25.84 million units of Maple Gold Mines Ltd. for \$0.239 per unit for total consideration of approximately \$6.175 million. Each unit is comprised of one common share of Maple and one common share purchase warrant of Maple. Closing is expected to occur on or about October 9.

Agnico Eagle and Maple have entered into a binding term that will consider the formation of a 50/50 joint venture, which will combine Maple's Douay project and Agnico Eagle's Joutel project into a consolidated joint property package. The Douay project and Joutel project are adjacent properties located in the Abitibi region of Quebec, and the Joutel project hosted Agnico's past-producing Telbel mine.

According to the binding term sheet, Agnico Eagle will fund \$18 million in exploration expenses over a four-year period;

Agnico Eagle and Maple will jointly fund an additional \$500,000 in exploration of VMS targets on the western portion of the Douay Project; and both will be granted a 2% NSR on the property that they contribute to the joint venture, each with aggregate buyback provisions of US\$40 million.

Agnico Eagle currently owns 11,764,706 common shares, representing approximately 4.4% of the issued and outstanding common shares on a non-diluted basis. Upon completion, Agnico Eagle will own approximately 12.84% of the issued and outstanding common shares on a non-diluted basis and 19.9% of the issued and outstanding common shares on a partially diluted basis.

Yamana Gold Expands Footprint With Monarch Acquisition

Yamana Gold Inc. has agreed to purchase the Wasamac property and the Camflo property and mill in Quebec from Monarch Gold Corp. Yamana will acquire the properties through the acquisition of all of the outstanding shares of Monarch not owned by Yamana, including cash and shares, of approximately C\$152 million. Monarch will complete a spinout to its shareholders, through a newly formed company of its other mineral properties and certain other assets and liabilities of Monarch.

The Wasamac gold underground project, located 15 kilometers (km) west of Rouyn-Noranda in the Abitibi region of Quebec, consists of five well developed ore shoots within a single, continuous shear zone with a consistent grade distribution and wide mining widths. It has existing proven and probable mineral reserves of 1.8 million ounces (oz) of gold

at 2.56 grams per metric ton (mt). Yamana said there is "excellent potential for significant future exploration success and mineral resource conversion."

Yamana said the geological characteristics of the Wasamac ore body suggest it holds the potential to be an underground mine achieving the same scale, grade, production, and costs as the company's Jacobina mine in Brazil, and it possesses many parallels to the company's 50% owned Canadian Malartic underground project located in the same Abitibi region in Quebec.

Yamana said it plans to commence an exploration and infill drilling campaign and other studies to refine and expand upon the potential of Wasamac and its development alternatives.

The Camflo property, located 15 km northwest of Val-d'Or, includes the old Camflo mine, which closed in 1992, and a permitted mill. The property has not been explored since the mid-1980s and Yamana believes it has good exploration upside.

The acquisition provides the company with a high-quality project with a significant mineral reserve and mineral resource base and excellent potential for further expansion, according to the company. The acquisition adds to the company's footprint in the Abitibi region, which Yamana said is consistent with its strategy to build on its existing presence in established mining jurisdictions. In addition, the acquisition of the Wasamac and Camflo properties adds to its pipeline of organic opportunities, significantly enhancing the company's future growth prospects, the company added.

The transaction has been approved by the boards of directors of Yamana and Monarch. In addition to Monarch shareholder approval, the transaction is subject to applicable regulatory, court, and stock exchange approvals and certain other closing conditions. The companies are working toward closing the transaction during 2020 and not later than early January 2021.

Ownership in SpinCo, a newly created exploration company, will hold Monarch's remaining pipeline of development and exploration projects, including the Beaufor mine, Croinor property, McKenzie Break property, Swanson property and Beacon mill.

It is expected that Monarch's senior executive team will continue in the same roles at SpinCo, and that SpinCo will have C\$14 million in cash to support its work programs and for general corporate purposes.



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Patrick Boitumelo

Vale appointed **Patrick Boitumelo** as the new head of mining and milling for its North Atlantic operations in base metals. Boitumelo, who has more than two decades of experience in the industry, has been with the company since 2019, when he was hired as head of technology and innovation in base metals. Previous to his tenure with Vale, Boitumelo served as president and COO with Diavik Diamond Mines in Yellowknife.



Mike Ciricillo

Nevada Copper Corp. appointed **Mike Ciricillo** as acting CEO. Ciricillo was previously the head of copper operations for Glencore, where he oversaw company's worldwide copper assets. Prior to Glencore, he has held a number of senior management roles during a 20-year tenure with Phelps Dodge and Freeport McMoRan, including as president of Tenke Fungurume Mining and general manager of Miami Arizona Operations. Ciricillo will assume the role of acting CEO from Evan Spencer.



Steve Higgins

Freeport-McMoRan announced that **Steve Higgins**, its senior vice president and chief administrative officer, has been elected chairman of the International Copper Association (ICA) and chairman of the London Metal Exchange's (LME) Copper Committee. Higgins has 40 years in the metals industry, including nearly 30 years with Freeport. He currently serves as chairman of The Copper Club Board of Directors. Beginning in 2019, he assumed expanded management responsibilities for administration within FCX and has played a significant role in supporting the company's response to COVID-19.



Mike Eiselein

Hycroft Mining Holding Corp. appointed **Mike Eiselein** to the position of vice president, general manager, of the Hycroft mine. At Newmont Mining Corp., Eiselein led the process and metallurgical departments at the Cripple Creek & Victor mine and was also director of full potential maintenance and reliability for Newmont's Nevada operations. Effective upon Eiselein's appointment, **Larry Giegerich** will step down from his role as vice president, general manager.



Cassandra Joseph

Bunker Hill Mining appointed **James Stonehouse** as vice president of exploration. Previously, he was the vice president of exploration at Americas Gold and Silver Corp. The company also appointed **Cassandra Joseph** to its board of directors. Also, **John Ryan** has retired from the board after having served as a director since 2016 and previously as CEO. Joseph is currently senior vice president, general counsel and corporate secretary for Nevada Copper, having previously been associate general counsel for Tahoe Resources until it was acquired by Pan American Silver Corp. in 2019.



Andrew Francis



Mark Roberts

Bardoc Gold Ltd. announced two senior appointments to its management team. **Andrew Francis**, who previously oversaw the prefeasibility study on the Bardoc Project, has been appointed to the expanded role of COO. He previously worked in technical and management roles within Northern Star Resources and has also held senior and management roles with companies such as Barrick, Byrnegut, Entech, MMG and Gold Fields. **Mark Roberts** will also join the Bardoc team as project manager. Roberts was previously a senior process engineer with GR Engineering Services Ltd.



Anna Ladd-Kruger

McEwen Mining Inc. appointed **Anna Ladd-Kruger** as CFO. Most recently, she was the CFO and vice president of corporate development at Excellon Resources Inc. She was also the CFO of Trevali Mining Corp.



Andrea Sutton

Red 5 Ltd. appointed two executives. **Andrea Sutton** was appointed to the board as a nonexecutive director. Sutton has more than 25 years of experience with Rio Tinto and ERA. Between 2013 and 2017, Sutton was chief executive and managing director of ERA, then a nonexecutive director from 2018 to 2020. **Jason Greive** was appointed COO. Most recently, he was COO at RTG Mining.



Christopher Penna

Christopher Penna, engineering coordinator, Meliadine, Nunavut, is the 2nd Annual 2019 **Larry Connell Award** for Collaborative Excellence recipient. The award was created to recognize employees for the key qualities Connell exemplified throughout his remarkable career. Recipients are selected based on their impact, network and sphere of influence, both inside and outside Agnico Eagle, and for supporting the success of the company regionally or globally and in meeting the criteria outlined for the award. In recognition of his achievement, a donation of \$5,000 CDN will be made by Agnico Eagle on behalf of Penna to Embrace Life Council, a non-profit suicide prevention organization based in Iqaluit, Nunavut.



Mike Moehnke

Columbia Steel Casting Co. Inc. announced the return of long-time employee **Mike Moehnke** as sales and marketing director. Moehnke started his Columbia Steel career as product engineer, quickly worked his way up to engineering manager and then spent his last nine years as the district manager. He then spent seven years as vice president of engineering and sales at VR Steel.



Charlie Ingram

Sandvik Mining and Rock Technology appointed **Ville Keinänen** as new business line manager, surface drills, USA. He has been at Sandvik since 2007, where he has been responsible for service, aftermarket, territory and general management.



Ville Keinänen

Eriez Executive Vice President and Chief Marketing Officer **Charlie Ingram** will retire at the end of 2020. Ingram joined Eriez in 1994 as national sales manager, rising to vice president of sales and marketing in 2004.



Chris Nawalaniec

After 16 years with the *Stedman Machine Co.*, **Chris Nawalaniec** becomes president. Nawalaniec, formally executive vice president, takes over from **Dennis Gilmour** after 42 years of leadership. Nawalaniec began October 2004 as the national sales manager in the Unit Sales Department then subsequently promoted to vice president of sales and marketing.



Chris Nawalaniec



Richard Jewell

The ACG and its board of management announced the passing of ACG founding Director **Richard Jewell**. Jewell was responsible in 1984 for establishing the Geomechanics Group within the UWA Department of Civil Engineering and then subsequently, in 1992, the ACG of which he was director until 2000. He worked predominantly in the area of mine tailings and paste and thickened tailings. Jewell continued his involvement with the ACG until 2018 as co-chair of the ACG's International Conference series Paste and Thickened Tailings. He was co-editor of the three editions of the ACG handbooks of Paste & Thickened Tailings – A Guide.



Robert E. "Bob" Murray

The founder and former CEO of *Murray Energy Corp.* **Robert E. "Bob" Murray** died on Sunday, October 25, less than a week after announcing his retirement from American Consolidated Natural Resources (ACNR), the entity that was formed following Murray Energy's emergence from bankruptcy in mid-September. He was chairman of the board for directors for ACNR. Murray began his more than 60-year career as a coal miner at North American Coal Corp., ultimately serving as president and CEO before founding Murray Energy Corp.



China Coal & Mining Expo 2021

China's 19th International Technology Exchange & Equipment Exhibition on Coal & Mining

Date: **26-29** October, 2021

Venue: New China International Exhibition Center (NCIEC)
Beijing, China

Host:

China National Coal Association

Co-host:

China National Coal Group Corp.

Organizers:

Together Expo Limited
China Coal Consultant International



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Argyle Diamond Mine Operations Wind Down



An LHD exits the Argyle mine portal, which can trace its roots back 37 years.

After 37 years of operations and having exhausted its economic reserves, the iconic Argyle mine in the remote east Kimberley region of Western Australia has celebrated its final day of mining. Argyle employees, traditional owners and local stakeholders attended an event at the mine, signaling the formal transition from an operational mine to the commencement of closure. The closure process is expected to five years to decommission and dismantle the mine and undertake rehabilitation, followed by a further period of monitoring. Argyle will employ a smaller workforce post the final mining and diamond production activities, continuing to contribute to the local economy.

"Fifty years ago, there were very few people who believed there were diamonds in Australia — even fewer could have foreseen how the Argyle story would unfold," Rio Tinto Chief Executive of Copper and Diamonds Arnaud Soirat said. "To arrive at this final chapter has required vision, courage and determination to overcome significant challenges to enter new territory in diamond exploration, mining and marketing.

"Today, Argyle's influence stretches into many spheres and over many continents and I am very proud to acknowledge all those people who have contributed to the discovery and development of the

mine and the production of some of the finest diamonds the world has ever seen."

The Argyle ore body, a single pipe known as AK1, was discovered in October 1979. Alluvial operations began in 1983, open-pit mining began in 1985, and the mine became a fully underground operation in 2013. Over this period of time, the mine has produced more than 865 million carats of rough diamonds, becoming the world's largest producer of colored diamonds and virtually the sole source of a very small but consistent source of rare pink diamonds.

"This is an historic day for the Argyle mine and the east Kimberley region and a great source of pride for this unique Australian success story," Argyle Mine General Manager Andrew Wilson said. "A new chapter will now begin as we start the process of respectfully closing the Argyle mine and rehabilitating the land, to be handed back to its traditional custodians."

Fenix Purchases Port Infrastructure

Australian iron ore junior Fenix Resources is buying the iron ore storage shed, and the truck unloading and conveyor systems located at the Geraldton Port in Western Australia from Sinosteel Midwest Corp. (SMC) for \$1 million. The purchase is on an as-is, where-is basis, with Fenix having already

conducted a detailed assessment of the infrastructure and established a recommissioning plan that should see the facility ready to accept iron ore haulage trucks in December, according to the company.

Fenix said it is working closely with the Midwest Ports Authority to execute the port services and port lease agreements, now that it has secured a port storage and trucking unloading solution at the Geraldton Port.

"We believe that we have secured a strategic asset that should facilitate the timely development of the Iron Ridge project by gaining access to bulk export facility," Fenix Managing Director Rob Brierley said. "We look forward to fostering our strong relationship with Sinosteel further."

SMC owns the Weld Range Iron Ore project, which is adjacent to Fenix's Iron Ridge Project. In addition to the port infrastructure acquisition, SMC and Fenix have reached agreement to cooperate on commercial terms to ensure the Iron Ridge project has the necessary area to fit all of its infrastructure during the economic life of the Iron Ridge Project.

Processing Modifications Pay Dividends for Hellyer

NQ Minerals reported that processing circuit modifications at its Hellyer operations are continuing according to plan, and production rates have been increased further to 165 metric tons per hour (mt/h) as of the end of September. "We are continuing to see much improved production and revenue performances from NQ's flagship Hellyer polymetallic operations in Tasmania, Australia," said NQ Minerals Executive Chairman David Lenigas. "The efforts being exerted by our dedicated management and staff are producing very significant leaps forward with respect to the way Hellyer performs. Our Hellyer focus for this coming quarter is targeted toward furthering our plant output initiatives."

The company is finalizing designs and operational procedures to further increase production to 180 mt/h, which would equate to roughly 1.5 million mt/y.

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Minera Alamos Will Speed Up Cerro de Oro Development

Minera Alamos Inc. announced it is fast-tracking development activities at the Cerro de Oro gold project in Zacatecas, Mexico. It has completed its internal evaluation of historical information and is in the process of finalizing an inaugural resource estimate for the project in the coming weeks. An updated geological model for the project is being prepared, which will act as the basis for a drill program focused on zones of potential resource expansion and to confirm the suitability of proposed locations for heap leach pads and ponds.

Metallurgical testwork demonstrated the amenability of oxide mineralization to gold recovery via cyanidation and that potential also exists for recovery from transition/sulphide mineralization.

The company said basic engineering for the permitting of a heap-leach gold recovery facility is under way with a target to submit permit applications for the project in early 2021.

A new detailed topographic survey has been completed that covers the core

claims as well as significant areas of surrounding land that are under consideration for both resource expansion activities and the construction of heap-leach gold recovery facilities.

Plans are under way for a hydrogeological survey of the concession to prioritize locations for process water access.

“In just a few short months since the Cerro de Oro acquisition, we have rapidly advanced the project on a number of parallel fronts,” CEO Darren Koning said. “All indications to date support our belief that the deposit is an ideal project for the design and development of another low-capital intensity heap-leach operation to expand the company’s future growth potential.”

The majority of the metallurgical testwork completed on samples from the Cerro de Oro project was performed during 2017 to 2019. Data from this preliminary work is being utilized as a starting basis for engineering designs that are currently under way,

according to the company. It has initiated a new program of metallurgical studies to provide additional details prior to the completion of final engineering designs.

Although the majority of the metallurgical work completed to date has focused on the oxide mineralization in the Cerro de Oro deposit, the results from a limited number of mixed oxide/sulphide transition samples did not appear significantly different than what was observed with the oxide material, the company said.

The company said upcoming metallurgical program planned for the project aims to confirm the results from previous studies and to further optimize the parameters to be utilized for construction of a heap-leach gold facility at the project.

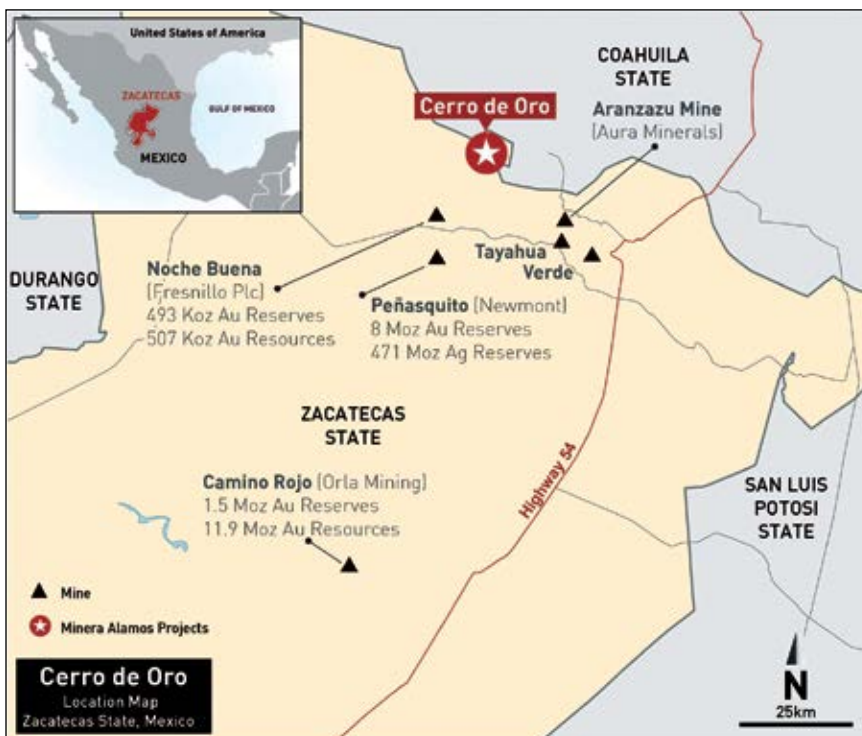
This will include coarse bottle leach optimization studies to evaluate crush size/gold recovery relationships; leach studies to specifically examine areas of mineralization associated with reduced host rock permeability and elevated copper contents; sulphide mineralization leach studies; hardness/abrasivity studies for major rock lithologies; and rock density determinations for different lithologies within the deposit.

Agnico Eagle Mines, Newmont Team Up for Colombian Gold Exploration

Agnico Eagle Mines Ltd. (AEM) has formed an exploration joint venture (JV) in Colombia with Newmont Corp. The 50/50 JV, which will be operated by Agnico Eagle, will explore the Anza project and seek other prospective gold targets of district-scale potential in Colombia.

“The Anza project is well located within the Mid-Cauca belt in Colombia, which hosts several world-class gold deposits,” Agnico Eagle Senior Vice President of Exploration Guy Gosselin said. “Historical work on the project indicates the potential for various styles of mineralization, including porphyry, epithermal and VMS.”

Gosselin added that the company has been looking in the area for a while and this “low-cost entry” is consistent with the



The Cerro de Oro project could soon become the newest heap-leach gold mine in Zacatecas, Mexico.



The Anza project is located within Colombia's Mid-Cauca gold belt.

company's exploration strategy and existing investment in Royal Road Minerals.

The Anza project is a gold exploration project, comprising exploration contracts and applications totaling approximately 200 km² located in the Mid-Cauca belt in Colombia. The project is 50 kilometers (km) west of Medellín and 60 km south from Zijin Mining's Buritica operation. Newmont previously announced an exploration agreement with Orosur Mining with respect to the Anza project in 2018.

Agnico Eagle will solely fund the JV until expenditures equal Newmont's previous investment in the Anza project, approximately \$2.9 million, which is expected to be achieved in the next 12 months. Thereafter, the parties will continue funding on a 50/50 basis.

Andina Sees Significant Results From Processing Modifications

Improvements in operational routines, maintenance, reportability and coordinated teamwork have resulted in significant improvements in the results of the Molybdenum and Copper Filtration Plant (SPMFC) of Codelco's Andina Division, according to the company.

Last July, the area began a comprehensive review of its processes, in order to identify and solve the problems that affected its performance. The availability of conventional filtering was increased considerably as well as the effective treatment, generating a production increase of 60%, reaching 18,352 metric tons (mt) of fine copper.

"The problems were highlighted and in an integral way between supervisors,

operators and maintainers, we are solving them," said Eduardo Morín, superintendent of the SPMFC of the Andina Division. "We knew the transformation was possible and it required some modifications to address problems."

MAG Silver Announces First Production From Juanicipio

Development material from the Juanicipio project, a joint venture between Fresnillo plc and MAG Silver Corp., commenced processing at the Fresnillo beneficiation plant during the quarter ended September 30. During the quarter, 42,476 metric tons (mt) were processed, with total production of 394,000 silver ounces (oz), 610 gold oz, 138 mt of lead and 174 mt of zinc.

This first development material was processed through the nearby Fresnillo processing plant with the lead and zinc concentrates treated at market terms under off-take agreements with Met-Mex Peñoles in Mexico. The revenue from this production, net of processing and treatment costs, will be used by the joint venture to offset cash requirements of the initial project capital.

"This first production from Juanicipio is a major milestone for the company," MAG Silver President and CEO George Paspalas said. "The successful processing of development material not only provides cash flow to offset capex, but further de-risks the project as it heads toward commercial production.

"We are looking forward to the first production stope coming online in Q4 2020, and our potential to continue to produce cash whilst we complete the process plant construction."

Fresnillo expects to process an average of 16,000 mt per month of mineralized material from the joint venture through its processing facility to mid-2021, at which time the Juanicipio beneficiation plant is scheduled for commissioning.

Development continues on site and the final preparation of the first production stope was concluded during the third quarter. Also during the quarter, progress was achieved on the construction of the Juanicipio processing plant.

Four Points Will Become Soma Gold Subsidiary

Soma Gold Corp. has entered into an agreement with two Mineral FF SAS and Rulvix Holding Inc. to purchase 25,992 common shares in Four Points Mining SAS. As a result of the agreement, Four Points will become a 100% owned subsidiary of Soma. Four Points is the owner and operator of the El Limon mine in Antioquia, Colombia. Soma currently holds approximately 88.1% of the issued and outstanding common shares of Four Points.

"Now that Soma will own 100% of Four Points, Soma can integrate operations at El Limon and El Bagre owned by Soma's other wholly-owned subsidiary, Operadora Mineras SAS," Soma Executive Chairman Geoff Hampson said. "The two properties and mills are on contiguous properties, and management feels that there is a good chance that the mineralized trend crosses from one property to the other."

Integrating the two companies will allow Soma to obtain synergies from operating in Colombia as one wholly-owned subsidiary, he added.



Socially-distanced, Andina millworkers celebrate the improvements at their filtration plant.

Polyus Reports Maiden Reserve Estimate for Sukhoi Log Gold Project



In-fill drilling continues to further define the massive Sukhoi Log gold deposit.

Russian gold miner PJSC Polyus reported a maiden ore reserve estimate for its Sukhoi Log project at 540 million metric ton (mt) with an average grade of 2.3 grams per mt of gold and containing 40 million ounces (oz) of gold as of May 31. This estimate ranks Sukhoi Log as the largest gold deposit both among greenfield assets and operating gold mines, according to the company.

This 2020 Sukhoi Log ore reserve estimate is based on the 2019 mineral resource model as well as a number of studies and additional mine planning activities undertaken by AMC Consultants.

"The publication of the maiden Ore Reserve estimate represents a significant milestone for Polyus' long-term development strategy, and confirms Sukhoi Log's position as one of the world's highest-caliber gold deposits," Polyus CEO Pavel Grachev said.

The addition of 40 million oz of gold, secures Polyus' top-2 position among the world's largest gold mining companies by attributable reserves.

The estimated mineral resources for Sukhoi Log stand at 1.11 billion mt, with an average grade of 1.9 g/mt Au and containing 67 million oz of gold as of May 31. An exploration drilling program throughout 2019 enabled an increase of the estimated indicated mineral resource by 18 million oz to 46 million oz of gold.

Polyus continues in-fill drilling campaigns. This drilling is designed to improve the confidence of inferred mineral resources and will allow the company to better define the gold mineralization within the future pit area, where Polyus said it expects to carry out mining activities during the first years of Sukhoi Log's operations. The company is also proceeding with further geotechnical drilling.

"We continue to focus on the next stages of the project's development," Grachev said. "We expect to provide the next update on Sukhoi Log later in 2020, with the announcement of the prefeasibility study results."

Oceanagold Lays Off First Round of Employees at Didipio

OceanaGold Corp. has implemented the permanent layoff of 496 OceanaGold (Philippines) Inc. (OGPI) employees. The employees are predominantly from local communities in the provinces of Nueva Vizcaya and Quirino. Along with the termination of direct employees, approximately 400 people working with contractors are also impacted. The company said it may be required to implement a second round of permanent layoffs in mid-November and has provided notices to affected employees.

"Today is a sad day for the company and for the many hundreds of workers and their families whose livelihoods have been impacted by the local government blockade of the public road pending the FTAA renewal, which has constrained our ability to continue operations over the past 15 months," OceanaGold President and CEO Michael Holmes said. "The company has actively participated in community-led dialogue supported by the majority of the village and municipal governments, along with the majority of local residents in Didipio."

Despite these efforts, OceanaGold said a small group of local leaders have refused to consider access arrangements that would have preserved jobs.

"The FTAA renewal remains with the Office of the President for decision," the company said. "We continue to engage with the national government who express their support and endorsement of the renewal."

The company said it would work quickly to rehire workers and restart operations should the FTA be renewed or blockade lifted.

India Plans Maiden Foray Into Potash Mining

By Ajoy K. Das

India has started laying down a road-map to make a maiden foray into potash mining, marking a small step in reducing its 100% import dependency on this critical fertilizer mineral.

Preserving Federal Mineral Access

By Daniel Jorjani

I've noticed a tendency over the years I've served at the Department of the Interior. Former mining towns — which can trace much of their wealth and land ownership to the 1872 Mining Law making certain federal lands available for mining — balking at nearby mine operations and adopting a “not in my back yard” posture to halt those activities through lawsuits, implicitly but necessarily, working to shift those operations to someone else's neighborhood.

This tactic is familiar: proponents of changing a law do not succeed in accomplishing their goal through the representative democracy process and — having failed to persuade legislators to change the law — the advocates turn to the judicial branch to try to gut the offending law. In context of the Mining Law, the town attempts to radically revise a 150-year-old grant of rights by reversing the department's straightforward application of that law.

There is nothing illegitimate about asking courts to settle legal disputes, and statutes have no doubt been subjected to flawed interpretations that judicial review can highlight and resolve. But in this case, the proponents of reinterpretation are not simply petitioning the courts to settle a legal dispute, they are attempting to subvert the Mining Law's longstanding grant of rights to use open lands to develop minerals. And what happens if such arguments win the day and mining operations cease to exist on our federal lands here in the United States? Mining doesn't stop, of course, it simply moves somewhere else. That's bad for the environment. Unlike many other countries, the United States has strong environmental laws enforced at multiple levels of government. Moving mineral development abroad also leads to the loss of associated American jobs, where employees are protected by robust labor laws.

We know that mining and its associated employment will move abroad because we simply cannot live without mineral production. Minerals produced under the Mining Law include, among many others, copper, silver, gold, lead, zinc, molybdenum and uranium. The United States is already import-reliant for 31 out of 35 critical minerals.

President Donald Trump and his administration are working to encourage the identification of new sources of critical

minerals, increase exploration and mining activities, and streamline leasing and permitting processes to expedite, among other things, the exploration, production and processing of critical minerals.

Of course, citizens are right to pay attention to the natural environment and to the effects mining can have on the landscape, vegetation, wildlife and recreation. The government rightfully prosecutes abuses of the laws that govern mining and protect our environment from unnecessary harm. But in this case, the aversion to local mining is not supported by the facts.

The United States has a multitude of federal environmental laws that provide transparency and protection for Americans. These include the Clean Air Act, the Clean Water Act and the National Environmental Policy Act, to name just a few. These laws help federal, state, and local regulators address environmental concerns and minimize impacts of concern. It's not a coincidence that there have been no Superfund sites associated with mining operations under the Mining Law since the Bureau of Land Management began regulating them in 1980.

Congress can and has considered reforms to the 1872 Mining Law, but this administration is acting within the scope of its authority under that law to safely and effectively advance the production of minerals domestically, as a good steward of federal resources and a good neighbor enforcing strong regulatory controls.

I am therefore pleased that the Department of the Interior Solicitor's office is able to further the administration's goals with its August 17 issuance of a legal opinion (M-37057) that builds on prior analyses of the Mining Law and clarifies the legal principles that support the department's longstanding application of that law. The opportunity for citizens to access and use our country's public lands to develop minerals has contributed to America's progress and historical innovation. I am hopeful that our work at the Solicitor's Office will reaffirm and advance the department's commitment to protecting and managing the nation's natural resources for the benefit of the American people.

Daniel Jorjani is solicitor of the U.S. Department of the Interior.

Strangely, the desert state of Rajasthan has estimated potash reserves of 2.4 billion ton or about 90% of total domestic estimated reserves but the country has no mining project for extraction of the fertilizer mineral and is completely dependent on imports of the input for domestic production of potassic fertilizers.

However, this is slated to change with a Memorandum of Understanding (MoU) between Rajasthan State Mineral and Mining Ltd. (RSMML) and government-owned Mineral Exploration Corp. Ltd. (MECL) to undertake a feasibility report of mining potash at the Satipura block with estimated reserves of 133 million tons.

While the state government has not yet made a final decision, the option to put the block up for auction after completion of the feasibility report followed by the technoeconomic viability report, was on the table, according to a government official.

Satipura was a deep-seated block with extractable potash at depths ranging 450-700 meters and mineral content of around 4%-5%. But the low mineral content could be offset in terms of viability through simultaneous extraction of other embedded minerals like industrial salt and polyvinyl chloride.

The significance of the country's foray into potash mining can be gauged against it importing its entire requirement for potassic fertilizer production of 4 million tons of potash annually. But India's imports in the global trade of the mineral is around 7% compared to China accounting for 20% of total global share. China sets the benchmark international price, which Indian importers have to pay, thereby increasing the domestic price of the fertilizer.

A major source of Indian potash imports is from ICL Group, Israel, the sixth largest potash producer in the world with a supply contract for 410,000 mt signed in May 2020 for shipment between June-December 2020.

In the same month, India also concluded a supply contract with world's largest producer, Urakali for inward shipment of undisclosed tonnage at around \$230 per ton CFR, and about \$10 per ton higher than import contracts concluded by China.

Recurring Theme of Optimism at Annual Jo'burg Indaba Symposium

By Gavin du Venage

The South African mining industry is returning to form as COVID-19 retreats and policy changes open the sector up again.

The annual Jo'burg Indaba symposium, held in Johannesburg, revealed a steadily growing optimism that the long-neglected sector was in recovery.

The Jo'burg Indaba — not related to the rival Mining in Africa Indaba held in Cape Town — brought together industry leaders for two days of video discussion in October. The overall theme was an increasing optimism that government and miners were bringing the local industry back to form.

“One of the unique features of this event is that it is focused and intimate,” convener Bernard Swanepoel said. A former miner himself — he once held the CEO position at Harmony Gold — Swanepoel promised an event full of “blunt talk” from industry leaders, with no side events or “PR spin.”

Anglo American CEO Mark Cutifani kicked off the event by laying out the urgent need for policy change, a theme he acknowledged has existed for the past decade at least. The industry had been calling for a reset for some time without effect, but “this time, it feels different.”

“We spent much of the past 10 years trying desperately to navigate ourselves out of an uncertain and unworkable policy environment,” he said. As a result, production remained at the same levels as the early 2000s, investment stagnated, and South Africa consistently ranked in the lower half for attractiveness to mining companies.

However, the government had begun to talk to the miners and was winding back on policy obstacles, such as its previous insistence that black shareholders had to be a permanent feature of mining companies. The state had also begun to reverse the catastrophic decline in crucial sectors, such as national rail operator Transnet, and electricity supplier Eskom.

“I think we have more reason to believe in the success of the mining industry, than not,” Cutifani said.



Anglo American CEO Mark Cutifani tells the Jo'burg Indaba he remains optimistic about South Africa's mining future. (Photo: Anglo American)

Thabo Mokoena, director general of the Department of Mineral Resources and Energy, built on this theme, noting that electricity outages had been a severe hindrance to the industry. “When the supply of electricity is unreliable, investment in extraction becomes a challenge,” Mokoena said.

The government recently deregulated self-generation of under 1 megawatt (MW), which meant private providers could now generate their own electricity to that level, without requiring any permits. Additionally, around 11,000 MW were being procured from a range of sources, including wind, gas and solar. Crucially, coal would remain part of South Africa's energy mix for some time to come.

The government was especially eager to develop “clean coal” technology.

“It can't be completely clean, but can be improved through technology,” Mokoena said. “We don't want to neutralize our coal resource.”

His department was also working on the speeding up of issuing exploration and other permits. “We will prioritize shovel-ready investments with permitting issuing.”

Energy Issues

Energy remains a burning topic for the local mining industry. Local utilities are heavily reliant on coal that in turn underpins coal mining and mines themselves have struggled to overcome constant power outages, a result of the troubles besetting Eskom.

Eskom CEO André de Ruyter outlined a strategy he said will have blackouts largely eliminated by late next year. Eskom has begun the midlife refurbishment of its ageing fleet, most of which should have been done years ago.

He reiterated what Mokoena said earlier, that coal would remain part of South Africa's energy mix for many years to come.

“The goal is for a just transition to low carbon future,” he said. “The emphasis is on ‘just,’ as we can't simply transition away from coal and leave those communities dependent on it in the lurch.”

Tenders had already been issued for 250 million metric tons (mt) of coal over the next 20 years. Mining companies were also invited in new mines, with Eskom as their major client.

In the meantime, Eskom will also construct a series of conveyer belts to connect mines with the coal power plants. Most of the existing fleet have already exhausted their nearby resources, and now rely on mines up to 40 kilometers away.

Eskom has been relying on trucks, which clog up the roads. The trucking fleet has also been linked to shady contracts, and the utility has begun to undo years of corruption under previous managers.

Since de Ruyter's appointment, criminal charges have been filed against a dozen former board members. “And fair warning, we will continue to take action against those who seek to take advantage of Eskom through corruption,” he added.

Go North

The Northern Cape province situated on the upper west of the country, enjoyed special attention during the Indaba. Historically, the region is known for diamonds, iron ore and more recently, zinc. Yet, recent exploration showed it had the potential for much more.

“The Northern Cape is a dripping roast for miners,” said Errol Smart, CEO of Orion Minerals, a junior explorer operating in the area. So far, 23 minerals of interest had been identified, including iron ore, platinum and nickel.

The area hasn't been explored since the 1980s. "It's an extremely promising environment, which hasn't been touched by modern exploration technology," Smart said.

So promising is the Northern Cape that the state body Council for Geoscience has made the region its priority, said CEO Mosa Mabuza.

"We've dedicated the lion's share of our resources to the Northern Cape," he said. "We're finding interesting anomalies of nickel, chrome and cobalt. And huge traces of lithium."

A final word came from the doyen of South African mining, Sir Mick Davis. He was central to the creation of titans of global mining such as BHP Billiton (now just BHP), Xstrata and a former executive at Eskom.

Davis noted that mining companies learned from their mistake of over-investing during the previous commodities supercycle. Many companies over capitalized and when the boom ended, found themselves with projects that had no customers.

Now, companies prioritized returning capital to shareholders and were skittish about investing in exploration and new projects. This, he said, would eventually come back to bite them.

"Every single day that they take something out of the ground, that value disappears forever, and unless you do something to replace that value, you are going to end up withering and dying," Davis said.

He pointed to Rand Mines, once one of the largest gold producers in South Africa, as an example. The company withered and died because of the absence of investment in rebuilding and recreating value. Executives were always under pressure to pay dividends.

"But the bigger challenge is that mining companies have always been accused of excessive investment and destroying capital, and it is true that that is what has happened, over many years," he said.

Endeavour Restarts Boungou Mine

Endeavour Mining successfully restarted mining operations at its Boungou mine in Burkina Faso, following the mobilization of the West African mining contractor and completion of infrastructure and operating improvements. The mine was shut down by former owner, SEMAFO, in November 2019 after several fatal incidents



In early September, Endeavour awards the Boungou mining contract to SFTP Mining, a West African mining contractor.

occurred near the mine, including an attack on a convoy carrying employees that killed 39 people.

In addition, Endeavour confirmed potential annual synergies of \$35 million to \$40 million during its SEMAFO integration process. Endeavour acquired all of the issued and outstanding securities of SEMAFO back in July.

The identified synergies are in the areas of procurement and supply chain optimization, corporate and in-country G&A savings, centralization of technical services and functions across the group. It is estimated that 60% of these synergies will be progressively unlocked by year end 2020 and the remaining next year, according to the company.

"We are pleased to have restarted mining operations at Boungou, which marks a significant milestone in the integration process," Endeavour President and CEO Sébastien de Montessus said. "The newly acquired assets are now well embedded into our West African operating model, which is centered on an agile and streamlined management approach, based on empowered decision making at the mine level with shared regional support functions.

The Boungou plant has been processing stockpiles since early 2020. Following the acquisition, Endeavour has implemented a range of infrastructure improvements and new security and operating procedures for the mining restart program.

As announced in early September, Endeavour awarded the mining contract to SFTP Mining BF SARL (SFTP), a West African mining contractor, who also provides mining services at Endeavour's

Karma mine. SFTP immediately began to mobilize mining equipment and personnel and, to accelerate the restart, SFTP purchased a portion of the on-site fleet from the previous contractor. The mobilization of the remaining equipment is expected to be completed in the coming weeks. The Boungou mine and SFTP have prioritized local recruitment for the operations, with training currently in progress. The mine will employ approximately 1,100 people, including subcontractors.

During the fourth quarter of 2020, mining activities are expected to focus on the West pits, while preparing the East pit for grade-control drilling in 2021. Mining, drilling, and blasting activities are expected to continue to ramp up in the coming weeks to reach the contracted amount of approximately 2 million metric tons to 2.3 million mt per month.

The Boungou mine is now expected to achieve the top half of its 2020 production guidance of 130,000-150,000 oz at an AISC of \$680-725/oz due to the addition of high-grade mill feed from freshly mined ore.

Exploration activities are expected to resume in the fourth quarter of 2020, targeting near-mill targets.

As part of the restart plan, Endeavour, in close partnership with the Burkinabe government, has implemented a comprehensive security plan, which includes a dedicated unit assigned to work with Endeavour to ensure the overall security of the mine and the region.

Security improvements at Boungou conducted by Endeavour include upgraded site infrastructure, detailed site

(Continued on p. 21)

Thiess Secures \$79M Caval Ridge Extension



Thiess will continue to operate and maintain three 600-mt excavator fleets at the Caval Ridge mine (above) to move additional overburden. (Photo: BMA)

Mining contractor Thiess recently signed a 12-month contract extension with BHP Mitsubishi Alliance (BMA) to operate its Caval Ridge mine in Queensland, Australia. The contract, valued at A\$110 million (\$79 million), calls for Thiess to continue to operate and maintain three 600-metric-ton (mt) excavator fleets to move additional overburden for the Caval Ridge.

"This contract extension builds on our relationship with BMA and reinforces our commitment to work with our clients to safely position their operations for optimal efficiency, productivity and cost performance," said CIMIC Group CEO Juan Santamaria.

CIMIC owns Thiess and is currently considering a sale of 50% of the mining contractor.

BMA is Australia's largest coal producer and supplier of seaborne metallurgical coal. BMA is owned 50:50 by BHP and Mitsubishi Development. Caval Ridge achieved a record annual production of 4.35 million metric tons (mt) in fiscal year 2020, compared to 3.97 million mt in fiscal year 2019.

The Thiess contract extension for overburden removal will commence in December.

China Orders Stoppage of Imports of Australian Coal

China's customs authorities have told several Chinese state-owned steelmakers and power plants to stop importing Australian coal, according to two industry newswire

services. The move comes amid ongoing tensions in the relationship between China and Australia and reportedly affects both thermal and coking coal.

The trade minister, Simon Birmingham, said the government was aware of the reports and was discussing the issue with Australia's resources industry, which had "previously faced occasional disruptions to trade flows with China."

The Minerals Council of Australia said it was also aware of the reports but played down any extended impacts, insisting the outlook for Australian coal remained positive in the medium term.

S&P Global Platts cited several unnamed sources as saying Chinese state-owned utilities and steel mills had received the verbal notice to cease the imports.

China has taken a range of actions against Australian exporters this year, including imposing prohibitive tariffs on barley, suspending imports from five red meat processing plants and launching two trade investigations into wine.

Government figures show Australia exported \$7.3 billion of coal to China in the first six months of this year, up 8% compared with the same period last year. The value of Australian exports of iron ore and concentrates to China rose 16% to \$43 billion.

According to S&P Global Platts, the entities told to cease importing Australian coal included Huaneng Power International, which describes itself as one of the largest listed power producers in China, as

well as Datang International Power Generation Co., Huadian Power International, and Zhejiang Electric Power Co. Ltd.

CIL Plans to Achieve 1B Ton Production Target

By Ajoy K. Das

India's state-owned Coal India Ltd. (CIL) has firmed up major investments between the current fiscal year and 2023-2024 across 500 projects to achieve a production target of 1 billion metric tons per year (mtpy).

During 2019-2020, CIL notched coal production of 602 million mt.

Providing a breakdown of the mega investments over the next four fiscal years, the Ministry of Coal said \$4.5 billion would be riding on construction of coal handling infrastructure across its mines, \$3.4 billion on mine infrastructure and \$4 billion on project development, assuming current exchange rate of INR 73 to a US dollar.

Additional investments would include a spend of \$4.4 billion on diversification and clean technologies like coal-to-methanol projects, solar power, \$259 million on exploration of virgin coal blocks, and \$205 million on social infrastructure.

According to the minister of coal, the miner would invest an estimated \$1.94 billion in two phases to construct 49 "first mile" connectivity across its coal mines. This would be for transportation of coal from pitheads to dispatch points and this would ensure higher efficiencies in coal handling enabling computer aided loading replacing the existing dependency on road transport involving manual loading.

Investments on construction of its own railway infrastructure and logistical handling equipment would involve additional investment of \$178 million and \$92 million in procuring its own freight wagon thereby reducing dependency on state transporter Indian Railways in allocating wagons at pitheads.

CIL has identified a total of 15 greenfield coal blocks for development through mine developer operators (MDOs) to reduce imports of dry fuel into the company. Total investments in developing these blocks has been estimated at \$4.7 billion of which its own contribution to the investment would be around \$2.3 billion.

(Regional News-Africa - from p. 19)

security plans, and an improved approach to the movement of employees, supplies and material. Endeavour also completed the construction of an airstrip to fly staff from Ouagadougou and Fada to site.

On-site employee housing has also been expanded to accommodate all local and expatriate employees within the site security perimeter during their rotation. Endeavour has contracted a local company to improve the maintenance of the roads, particularly during the rainy season.

Kibali is Expected to Deliver on 2020 Guidance

Barrick Gold Corporation's Kibali mine is on track to deliver at the upper end of its 2020 guidance, President and Chief Executive Mark Bristow said.

Kibali was the first underground gold mine in the Democratic Republic of the Congo and one of the largest in the world. It is a global leader in automation and continues to improve efficiency and productivity through ongoing technological innovation. In the third quarter, it set a new ore delivery record from underground, exceeding nameplate for the first time since the shaft was commissioned in 2018.

"Automation is often associated with reduced employment, but we use it as an opportunity to further upskill our workers and to reduce our need for expatriate specialists," Bristow said. "It is worth noting that Kibali — one of Barrick's elite corps of Tier One mines — is led by a predom-

inantly Congolese management team in line with our policy of employing and advancing host country nationals."

Bristow said brownfields exploration was extending Kibali's life by replacing reserves depleted by mining. Barrick's exploration teams are also hunting for the next Kibali elsewhere in the Congo.

During the past quarter, battery technology was successfully integrated into the Kibali power grid to augment the mine's three hydropower stations and offset the cyclical load of the winder. In line with Barrick's global move to cleaner energy sources, the new technology will further reduce the mine's carbon footprint and use of thermal power.

Following a meeting with President Félix Tshisekedi, Bristow said they agreed that Kibali created a thriving local economy to what was previously one of the most deprived regions in the Congo.

"The continuing paved extension to the Durba road will provide construction work for local contractors for the next three years," he said. "Community support continues to be reinforced through other initiatives such as the Renzi agribusiness project and the planned palm oil project."

The company is also committed to upgrading the Kokiza Training Center for engineers scheduled to start later this year, he said.

Additionally, utility buildings initially built as isolation wards during the Ebola outbreak and subsequently used as a quarantine center for COVID-19 cases will now be transitioned to a tropical disease center to serve local communities.

Theta Gold Mines Expedites Approval of EA

The South African Department of Mineral Resources and Energy (DMRE) has informed Theta Gold Mines Ltd. of its support for the application to amend Mining Right 83 (MR83) to also permit open-pit mining. MR83 is an approved and executed mining right and has an approved environmental authorization (EA) for underground mining activities, as well as approval for processing of ore and deposition of residues onto an existing tailings dam.

In a letter on October 26, the DMRE confirmed the application for EA to permit open-pit mining on MR83 is being reviewed and the record of decision should be finalized on or before the end of November.

The DMRE acknowledged and said it appreciated the progress Theta Gold has made in relation to its mining investment, which has potential benefits to the South African economy and the local municipal area in particular. The DMRE noted that the mining sector has been identified as one of the most important catalyst to stimulate economic growth in the country post COVID-19.

"We are pleased to receive the DMRE's confirmation of support toward our EA application for MR83 and its commitment for a decision by the end of November," Theta Gold Chairman Bill Guy said. "Through the EA process, Theta Gold has implemented a positive and holistic environmental strategy that has gained traction with local communities."

NEWS - CALENDAR OF EVENTS

MARCH 1-5, 2021: SME Annual Conference & EXPO, (Virtual). Contact: Web: www.smeannualconference.com.

MARCH 7-10, 2021: The annual meeting of the Prospectors & Developers Association of Canada, (Virtual). Contact: Web: www.pdac.ca/convention/attendee-info/pdac-2021-convention-goes-virtual.

MARCH 14-17, 2021: Haulage & Loading 2021, Hilton El Conquistador Resort, Tucson, Arizona, USA. Contact: Web: www.haulageandloading.com.

APRIL 19-23, 2021 Expomin, Espacio Riesco, Santiago, Chile. Contact: Web: www.expomin.cl.

MAY 4-6, 2021: Canadian Institute for Mining (CIM), Montreal, Quebec, Canada. Contact: Web: convention.cim.org.

MAY 4-6, 2021: US Coal Show/Longwall Edition, Pittsburgh, Pennsylvania, USA. Contact: Web: www.longwallusa.com.

MAY 11-13, 2021: 14th International Gold, Silver and Copper Symposium, Lima, Peru. Contact: Web: simposium-del-oro.pe.

JUNE 1-3, 2021: Euro Mine Expo, Kraft Center, Skelleftea, Sweden. Contact: Web: www.eurominexpo.com.

JUNE 7-11, 2021: Elko Mining, Elko, Nevada, USA. Contact: Web: www.ExploreElko.com.

SEPTEMBER 13-15, 2021: MINExpo INTERNATIONAL, Las Vegas, Nevada, USA. Contact: Web: www.minexpo.com.

Tailings Engineers Wanted...

Seven experts discuss how the mining industry can recruit, train and retain the tailings engineers it so desperately needs

By Carly Leonida, European Editor



Qualified and experienced tailings engineers are vital for the safe design, construction and management of tailings storage facilities. (Photo: Golder)

It's fair to say that the Brumadinho tailings dam collapse in January 2019 was the straw that broke the mining industry's back. Although shocking, in reality, it was the latest in a long line of tailings dam failures that have occurred over the past 20 years, and prior. Many of which, upon investigation, were attributed to human error.

In its Bulletin 121, published in 2001, the ICOLD [International Commission on Large Dams] reviewed the case histories of 221 tailings dam failures and found that, in most cases, "a general lack of understanding of the features that control safe operation of tailings dams, with failures being caused by issues that should be managed by site personnel."

The independent review panel that oversaw the investigation into the Mount Polley dam breach in 2014 also stated in their report that "tailings dams are unforgiving systems, in terms of the number of things that need to go right. Their reliability is contingent on consistently flawless execution... in operational diligence in monitoring... and in risk management at every level. All of these activities are subject to human error."

It has been known for some time that qualified and experienced tailings engineers are vital for the safe design, construction and management of tailings storage facilities (TSFs). However, widely varying regulation of tailings practices across the globe meant that, until recently, there was no way to ensure the provision of proper expertise at every site.

Brumadinho changed this. The event and its coverage in the media forced regulators, industry bodies and mining companies into swift action. The most notable move was the establishment of the Global Tailings Review led by the International Council on Mining & Metals (ICMM), the UN Environment Program and Principles for Responsible Investment.

The resulting Global Industry Standard on Tailings Management (GISTM) published in August 2020 was a milestone for the mining industry.

The standard specifies the requirement for four separate engineering positions: first, an engineer of record (EOR) or designer of record (DOR); roles held either by a senior practitioner at an independent engineering firm or an appropri-

ate in-house engineer. The EOR/DOR is "expected to have a broad overview of all aspects of a tailings dam through its life stages from concept to closure." Second, is a responsible tailings facility engineer (RTFE), a new role that will be held by a member of the operator team.

An independent tailings review board (ITRB) and/or a senior independent technical reviewer are also needed to oversee design, construction and monitoring as dictated by the tailings facility consequence classification rating. The latter role must be "an independent professional with in-depth knowledge and at least 15 years' experience in the field."

The standard also requires that TSF operators appoint an accountable executive within their management team. Although the appointee does not need to be an engineer, it is reasonable to expect that person to have understanding and experience in the field.

The stipulation for and emphasis on the importance of these roles can only be a good thing and, overall, the industry has welcomed the standard with open arms. It is fully expected that uptake will not be limited to ICMM's member companies (operating about 1,200 or 30% of TSFs globally) for whom compliance will become mandatory in stages over the next five years.

However, what if we don't have enough engineers to fulfill those future requirements? What if we barely have enough to fulfill our current tailings management needs to the level required?

Keeping Pace With Demand

Marc Arpin, global manager of SNC-Lavalin's Sustainable Mining Group, is based in Montreal, Canada. A geologist by training, Arpin has worked 34 years in the mining industry, and he spoke about the increase in demand the company has seen recently for tailings related services.

"Following Brumadinho, we immediately saw a change in awareness with an increase in demand for professional

services related to the sound design and management of TSFs,” he said. “There are some specialized services related to TSFs, for example, EOR services, where we noted an almost overnight increase in demand. We’ve also seen a sharp rise in demand for dam break analyses and seismic stability analyses.

“The launch of the GISTM will have a significant impact on how we approach tailings management, and the need for TSF-related expertise is clearly on the upswing to respond to this.”

Carl Burkhalter, a geotechnical engineer and partner at NewFields, who has been practicing in mining for nearly 30 years, reported similar: “These recent failures have really woken up the mining community, especially investors, to the issues and the risks [associated with tailings management],” he said. “I’m glad the standard got issued. I think it’s going to be a really positive thing for the industry.”

Prior to 2020, the mining industry was already facing significant competition for skilled people in tailings consulting, both from mine owners and from other sectors. However, with the release of the GISTM, there has been a systematic increase in the number of experienced people required from management, design and site engineering roles to operators on the ground.

David Brett, senior technical director for Mine Waste and Water Management at GHD, explained: “As an example, the position of EOR is now formally required by the GISTM. If there are an estimated 7,000 operating tailings dams in the world and one senior engineer can effectively be EOR for four or five dams, we need 2,000 people just for that role. Then we also need the design teams, construction teams and dam operations people... This becomes tens of thousands of skilled people.”

Peter Chapman is a practicing tailings engineer based in Perth, Australia. He is a principal at Golder, an EOR at multiple sites and leads the company’s Global Tailings Technical Community.

“Mining companies are seeking increasingly qualified tailings engineers for roles such as the RTFE,” he said. “Competence requirements have been formalized that define both the required skills and experience for EOR and RTFE roles, which constrains the available talent pool. Dam safety reviews and independent review boards are also now required

with greater frequency and at more sites, while needing to be independent from the design engineer. The cumulative impact is stretching an already constrained supply pool for appropriately skilled and experienced tailings engineers.”

Attracting Talent

Chapman’s colleague, Andy Haynes, leads Golder’s Mining Business in Canada. He is a practicing tailings engineer and principal at the firm.

“The industry is not motivating students to pursue mining, nor tailings, at the rate needed to meet the future demand for suitably experienced skilled professionals,” Haynes said. “Personally, I feel that responsible mining is critical to support the efforts to reduce the contributions to climate change, and to adapting to a changing climate. Mining is, therefore, a critical environmental industry. I believe this climate responsibility message needs to be reinforced so that a higher proportion of students can feel that a career in mining is a valuable contribution to being part of global climate solutions.”

Part of the challenge involves changing the way the mining industry, and especially tailings management, are perceived by young graduates. The engineering of facilities that contain residues is, frankly, not glamorous. However, it is a challenging and exciting field that offers the promise of a long and rewarding career path; many experts in this field have been practicing for 40+ years with no plans yet to retire.

One such person is Professor David Williams, director of the Geotechnical Engineering Centre at The University of Queensland and manager of the Large Open Pit Project. Williams was a member of the expert panel that investigated

the technical causes of the Brumadinho failure and sits on a number of ITRBs for mines, including Escondida.

“The widespread retrenchments and decline in mining industry recruitment since about 2010, the increasing unpopularity of the industry, and recent well-publicized and catastrophic tailings dam failures, have discouraged graduates from pursuing a career in mining, much less tailings management,” he said.

“The intent of the GISTM will not be realized without the availability and recruitment of tailings expertise and interest. Worse still, the ongoing unacceptable rate and impacts of tailings dam failures will not abate and may even increase. This would be catastrophic for the mining industry, and for its role in the supply chain for the goods people demand and aspire to globally.”

Arpin agreed: “In general, reputation is something the mining industry needs to address because it is not attracting enough people. There is a lot to captivate both young and older employees in mining, including more innovative technology than one may think. Mining and mining services companies could do a lot more to entice people into a mining-based career.”

SNC-Lavalin has ties with numerous universities and research institutes and has found those to be a successful means of scouting and recruiting talent.

“We have among our staff many former postgraduates who were recommended to us by professors and researchers, and we also like to hire interns because it’s a good way to expose future engineers to our tailings activities and to test their interest and skills early in their career,” Arpin explained. “If they like the experience, we may eventually hire them as permanent employees, and may also support



David Brett has been training tailings engineers and operators for over a decade, including overseeing a two-day operator training course hosted by GHD and Water Training Australia. (Photo: GHD)

them during their postgraduate studies by keeping them as casual employees, and through our academic support program.”

Professional organizations like the Society for Mining, Metallurgy & Exploration in the U.S. are doing much to raise the profile of tailings engineering through the dedication of conference streams to this topic, as is ICOLD and the Australian National Committee on Large Dams (ANCOLD).

“I personally have presented to university students and they seem to be interested and, as chair of the ANCOLD Tailings Dam Subcommittee, we always try to encourage students to annual conferences,” Brett said. “Creating awareness of our ability as tailings practitioners to influence these significant structures with mine operators to develop best outcomes for the project, environment and community through the full lifecycle of design, construction, operations and rehabilitation makes for a really rewarding career.”

While many universities and colleges have shuttered their mining programs in recent years, others are now expanding their scope to incorporate a greater focus on tailings management.

Dr. Christopher Bareither is associate professor of Civil and Environmental Engineering at Colorado State University (CSU). He is a driving force in developing the university’s teaching in this area, and said, from an academic perspective, events from the past 18 months and the resulting regulations have brought more awareness that tailings engineers exist and that they are very important.

“We need to encourage more students to pursue a career in tailings by making this career path known at the undergraduate and graduate level,” he said. “I believe there are a lot of students who would find tailings engineering fascinating if they knew about the option. At CSU, we introduce the concepts of tailings and mine waste in our undergraduate geotechnical engineering courses and emphasize the broad range of job possibilities that exist in tailings.”

In addition to his academic responsibilities, Bareither also serves as chair of the Tailings and Mine Waste Conference committee in Colorado, which will be held virtually this November. The committee is offering to support students with free registration to the event.

“The virtual Tailings and Mine Waste Conference this year presents an invaluable opportunity to engage students around the world, who typically may not have the option to attend the conference. I see this as a win-win-win scenario for students, academic programs and the mining industry,” he said.

Succession Planning

New graduates are of course a part of the solution. However, given the significant experience required in some engineering roles and the complexity of TSF structures, it could be sometime before recruits are ready to practice unsupervised.

While many senior practitioners continue working long after their expected retirement age thanks to their enthusiasm

for the subject they will, eventually, retire. The industry needs to put provisions in place now not just to attract and train new graduates, but to ensure qualified engineers already working in the field receive proper support and are retained.

“It’s a mining-wide problem,” Burkhalter said. “There are a lot of people retiring and not that many people coming in at the midlevels. We’ve really got to do a good job of keeping engineers engaged and in the business. It’s important to make sure the people we do have aren’t getting overworked.

“The other thing is, having expertise both on the owner/operator and the consulting side. Mining companies have got to nurture their staff too and make sure they’re compensated and kept happy.”

Arpin agreed: “Good succession planning is critical in ensuring that we will not have a generational gap. The good thing about senior dam designers is that many of them continue working with us, although not at the same level of intensity, for many years after they have retired. But it’s not easy to attract people to this line of work and keep them there for 30 or 40 years, so that’s another challenge we face.”

What Makes a Good Tailings Engineer?

The highly specialized and multifaceted nature of tailings engineering roles mean that most are, for want of a better term, developed “in-house.” They learn the trade by working hands-on under the supervision of senior dam designers and operators as part of a team, and field work is an integral part of this.

Most engineers come from a variety of educational backgrounds, predominantly civil, geotechnical and environmental engineering programs. While these do not guarantee that they have the skills required they are, currently, the closest disciplines to tailings management.

Tailings practitioners require knowledge of soil mechanics, water and the environment, combined with mining fundamentals. Specific relevant skills include geotechnical site investigation and laboratory testing techniques, numerical modelling, construction, and instrumentation, which can be obtained through formal education or on-the-job training.

“Tailings engineers should have an appropriate degree or masters in geotechnical engineering, or engineering geology,



“From a dam safety perspective, operators need to understand the designs they have, how the tailings management interacts with the design, potential failure modes, what conditions can set up potential for instability and what can trigger a failure,” says David Brett, senior technical director for mine waste and water management at GHD. (Photo: GHD)

ideally with some specialization in dam engineering and tailings management,” explained Williams. “They should also seek certificated courses in tailings management. Tailings operators should have an appropriate trade qualification, and undertake regular training in TSF operation. Tailings design engineers or EORs, plus third-party reviewers of tailings facilities, and ITRB members can also play a role in training and awareness.”

Arpin added to this: “Designing TSFs requires a multidisciplinary team. The core skills required are civil or geotechnical engineering, geology, earth sciences, hydrology, hydraulics, hydrogeology, geochemistry, but other disciplines might be needed also. For example, mechanical piping, structural process and electrical engineering.

“In some cases, you may need nine or 10 different disciplines in a team. But above all, the person who designs these facilities needs to be passionate about it. Sometimes engineers must work in remote locations under harsh climates and in various geographical settings. You have to be resilient and have an adaptable personality.”

Burkhalter agreed, adding: “I think experience with earthworks and mill operations is key, too, especially for RTFEs. On the operator side, new graduates need to get out on site and watch the guys that run the tailings dam. The key thing is learning how to deposit tailings sub-aerially.

“As design engineers, we always send our young engineers out to build TSFs as standard. They need to watch how the liner is put in, how the cover is put on the liner... because every dam is different.”

Going forward, there will likely be more emphasis on developing well-rounded tailings engineers with traditional skills plus a heightened awareness and understanding of related disciplines and stakeholders.

“It will require the ability to integrate teams and balance stakeholder priorities, with recognition that social and environmental factors will be primary drivers,” Haynes said. “Knowledge of dewatering and material handling, climate change and sustainability will increasingly become cornerstones of a tailings engineer’s skill set. Practitioners will need to be able to effectively communicate plans and designs with a broader set of stakeholders including surrounding communities.”

Training approaches will need to be adapted accordingly, and multidis-

ciplinary consultancies may have an advantage, as the ability to provide exposure to other facets of engineering is more readily accessible.

“At Golder, we’ve found that our ability to collaborate between disciplines, and draw on the skill sets of colleagues in adjacent disciplines of process engineering, hydrogeology, risk, climate change and community engagement, has benefited not only our tailings engineers, but our clients, and will remain a focus of ours going forward,” Chapman said.

Expertise will also be required in data management and use of remote surveying technologies such as drones.

Academic Learning on the Rise

Until relatively recently, there was little in the way of formal university training on tailings management, although Williams has been teaching mine waste management to undergraduate and postgraduate students at The University of Queensland for more than 20 years. This course is being replaced by a tailings-specific course on tailings design from next year.

Other courses are also emerging... In Canada, the University of British Columbia’s (UBC) Norman B. Keevil Institute of Mining Engineering now offers a graduate certificate program in Global Mine Waste Management, under the watchful eye of academic director, Professor Dirk Van Zyl.

In June 2020, the University of Western Australia (UWA) announced the creation of Future Tails — an educational program jointly funded by Rio Tinto and BHP. Over five years, the companies will invest \$4 million in training, research, education and practice to support tailings and waste management facilities.

Led by program director, Professor Andy Fourie, Future Tails will provide education, training, and professional development to senior executives, senior technical personnel, junior engineers and operational staff, both in Australia and internationally.

Program participants will be awarded micro-credentials from UWA and there will be opportunities to follow a postgraduate pathway, which will include a masters in tailings management.

In the U.S., CSU has also recognized the need for greater emphasis on tailings and is adapting its offering appropriately.

“In academia, we need to provide courses that are tailored to the skills a tailings engineer needs,” explained Bareither. “At CSU, we have been and continue to transition our graduate program in geotechnical and geoenvironmental engineering towards a focus on tailings and mine waste.

“We created a case-study based course entitled Mining Geotechnics, which covers the broad range of topics engineers encounter in mine waste. Each week, we cover a different topic (e.g., tailings, geochemistry, in situ testing, tailings storage facility planning and design, etc.) whereby I provide a background/overview discussion in the first lecture and then a practitioner provides a case study-based discussion for the second lecture. This course is very well received at the graduate and undergraduate levels and has motivated many students to pursue a career path in tailings.”

Alongside Mining Geotechnics, all of CSU’s graduate courses include aspects of tailings engineering; for example: containment systems for waste disposal; slope stability, seepage, and earth dams; and advanced soil mechanics.

“In addition, I will be developing a new course in spring 2021 centered on the topic of tailings engineering,” Bareither said. “Our goal is to create a graduate program that will educate and train students who desire a career in tailings.”

In July 2020, CSU, the Colorado School of Mines, and the University of Arizona announced they were joining forces to establish the Tailings Center of Excellence. The center is tasked with developing best practices for sustainable mine waste management and providing the education to uphold them. CSU is also collaborating with Georgia Tech, UC Berkeley and the University of Illinois on the Tailings and Industrial Waste Engineering Center — nicknamed TAILENG — to research safer waste storage systems and offer technical training.

Bareither is involved with both organizations. “Short courses are being planned for both TAILENG and the Tailings Center of Excellence starting in 2021,” he explained. “These will be developed from core expertise of the academicians involved and key practitioners that have invaluable experience and a passion for education.

“TAILENG short courses will be more technical in nature and aimed at folks with a background in engineering (e.g., civil and environmental, geological, geotechni-



Tailings sampling: a vital skill for prospective engineers and operators. (Photo: Golder)

cal) who may not have training specific to tailings. On the other hand, Tailings Center short courses will target a broader audience, for example, mill operators, contractors, regulators and business executives. We really want to leverage the best of what the two groups can offer to complement one another and avoid redundancy.”

Will collaborative efforts like these be key in addressing the skills shortage going forward? *E&MJ* asked.

“Absolutely!” Bareither replied. “To address the skills shortage of tailings engineers, we need collaboration. There are excellent programs on tailings and mine waste management offered at UBC, University of Alberta, UWA and The University of Queensland. Our goal is to create, collaborate and complement these existing programs.”

“The faculty at these other universities are incredible and have outstanding programs. However, there is an absence of any established program in the U.S. Thus, we absolutely see effective collaboration as the only means of improving the pipeline of motivated students entering the workforce as tailings engineers and enhancing the skills of practicing engineers.”

Like Williams, Bareither believes that when it comes to professional training, more responsibility needs to be shared between academicians and practitioners.

“Academicians have experience in course development and can effectively teach fundamentals,” he said. “However, practitioners are essential for all professional training as they have the first-hand experience to offer. Thus, collaboration will be the best approach to developing and sustaining an effective professional development program in tailings.”

Online Training Resources

Thanks to COVID-19, many organizations, both professional and academic, have taken their training courses online this year.

The six-week Professional Certificate in Tailings Management launched in September 2020 by the Australasian Institute of Mining and Metallurgy (AusIMM) has seen great success. The course is planned to be run twice yearly, and the first enrollment was closed at 110 global participants.

The syllabus enables participants to gain competency and expand their knowledge on the geotechnical, geochemical, governance, closure and socioeconomic considerations of tailings management. It involves six weekly 90-minute live and interactive webinars, each with assessments, requiring a total time commitment of six hours per week.

Williams largely provides the content, delivery and assessment for the course, along with five other tailings experts (including Golder’s Peter Chapman). He sees online resources playing a growing role in the training of tailings engineers going forward.

“Online tailings management courses, which can be developed within months by engaging tailings experts for content and delivery, should be expanded and made available globally,” Williams said. “These should have a rigorous assessment component, leading to professional certification. Such courses may be amenable to incorporation into university postgraduate coursework programs, such as graduate certificates, diplomas and masters. However, it takes a number of years to establish such university programs, and this route is not always the one favored by professionals.”

Williams has found that online delivery is most effective when it is live, interactive and engaging, in preference to passive online resources.

“Due to COVID-19 travel restrictions, it [online teaching] must replace face-to-face delivery. However, on-site instruction in the context of the particular tailings facility is crucial,” he explained. “This can involve formal on-site training and can also take advantage of site inspections by tailings design engineers or EORs, third-party reviewers of tailings facilities, and ITRB members.”

AusIMM already has a long waiting list for the second intake of the course, which will commence in February 2021.

Phoebe Tan, senior manager for strategy and international at AusIMM, said:

“The development of the course was in response to industry feedback requesting a practical, interactive learning experience addressing key issues in effective tailings management. It has been a pleasure working with Professor David Williams and other tailings experts on the development of this course. The strong uptake we’ve seen in our inaugural intake and the request for a second course is evidence of the need for world-class professional development in this area.”

Getting Out on Site

There is also a number of highly regarded, long-standing training offerings for TSF operators, such as that offered by Brett of GHD.

Brett has been training tailings engineers and operators for more than a decade. He explained that most people working in tailings design stumble into the field by accident; most hold qualifications in civil or geotechnical engineering, often with experience in water dams.

“On the operations side, most management personnel would have mining or metallurgical engineering qualifications, which has a little bit of tailings training, but most do not have much,” he said. “The new guidelines are requiring more civil engineering skills. My main focus is training the operators who are generally trades people (electricians, fitters operating pumps and pipelines). These are the people day-to-day on a dam who can be responsible for tailings discharge and water management.”

Brett oversees a two-day training course hosted by GHD and Water Training Australia. The certificate, issued under the Australian Vocational Education and Training (VET) System, delivers theoretical and practical sessions with inspection training for front line operators and managers. More than 1,000 TSF operators have achieved the qualification thus far.

“Tailings is not rocket science, but each site is unique,” he said. “From a dam safety perspective, operators need to understand the designs they have, how the tailings management interacts with the design, potential failure modes, what conditions can set up potential for instability and what can trigger a failure.”

“They need to be able to contribute to risk assessments, listen to their technical advisors and to question what they are doing. For my on-site operations training, engineers just need to be interested and

involved. They must always wear a ‘black hat’ when inspecting the dams, look for things that don’t seem quite right, and question and report potential issues.”

In-house Opportunities

Many independent engineering firms also offer in-house training programs, whether formal or informal, for their staff. Ongoing learning opportunities are an important part of career progression and are critical in staff retention.

GHD has always offered some level of training for its engineers in-house through mentoring, encouraging the presentation of papers at conferences and lunchtime presentations, but Brett said the company is looking to expand that.

“We’re currently planning and developing a more formal internal training course to upskill graduates and existing staff with civil and geotechnical qualifications who are keen to move into tailings in order to expand our resources and meet future demand,” he explained.

Golder has developed a multitiered training program, underpinned by its internal practice guidelines and an in-house *Tailings 101* course.

“We are currently expanding our internal training to incorporate the additional skill sets that we believe tailings engineers will require going forward,” said Haynes. “We aim to provide our engineers with a consistent program addressing the fundamentals, core competencies, supplemented by specific courses on topics as their knowledge expands. Every employee at Golder has a career development plan, and for our tailings engineers, we use this as an opportunity to create a learning road map for becoming the well-rounded professionals the industry demands.”

In addition to this formal training, the company has established an internal technical community for tailings — currently led by Chapman — that connects and supports its 700+ tailings practitioners.

“This global community exchanges ideas, new research and experiences, and allows for the ongoing development of staff and the practice in general,” Chapman said. “We’ve found that this, combined with formal mentoring, supports the transfer of knowledge between seasoned professionals and those just starting out in their career.”

Mentoring opportunities are also important at SNC-Lavalin.

“The most important training we offer our engineers is coaching and supervision from seasoned TSF designers,” said Arpin. “We’re lucky enough to have multiple members of staff each with more than 40 years of professional practice. That’s really a blessing for our young engineers who can benefit from their knowledge and expertise.

“We also offer young tailings engineers the opportunity to be involved in projects from inception to construction. Every engineer wants to see his or her design being eventually implemented; it’s a legitimate aspiration.

“On top of that, we provide support to attend training provided by the industry and universities, training on different software, and we support participation in conferences, workshops, seminars and knowledge sharing opportunities as much as we can.”

Burkhalter reported similar at New-Fields: “We do a lot of in-house training and mentorships,” he said. “If an engineer doesn’t naturally gravitate toward somebody senior, then we assign a person who can take them under their wing.

“We also are looking into expanding our training around instrumentation and remote sensing technologies. And we put a lot of focus on retention, because once our engineers are trained up, we don’t want them to leave.”

Staying for the Long Haul

How can retention be promoted?

“Good pay and good working conditions,” Burkhalter said. “Pay is not everything, but it’s still an important element.

“For a lot of young engineers, the work-life balance is more important and it’s hard to achieve that at a mine camp in the middle of South America, say. Good companies have setups that include extra-curricular activities and decent rotation schedules... things like that.”

As an industry, it needs to work out how to better share liability surrounding TSF design, construction and management because, despite best efforts and hopefully a significant reduction in the number of failures going forward, accidents will still occur. Currently, a lot of the liability for these events lies with the EOR or DOR and that can be off-putting for engineers considering a career in the field.

“That was a key topic at the 2019 Tailings and Mine Waste conference in

Vancouver,” said Burkhalter. “If you work for a big mining company as an EOR, RTFE or accountable executive, you’ve probably got back up behind you should anything go wrong. But there are a lot of small consulting companies for whom the price of insurance is constantly being increased, and it gets out of control.

“It’s not just the engineering firm that should hold all the risk; the operator and regulators and the state should have some responsibility in that, too.”

Given the shortage and growing need for tailings engineers, fast tracking of talent can also play an effective role in retention.

“To keep people happy, they need recognition, and salary is not the only way to do that,” said Arpin. “Something we [SNC-Lavalin] have been doing is fast-tracking the development and promotion of our best talents. So, as young engineers make their way up the organization, they are given new responsibilities if we see that they are capable. They have direct contact with clients, and they are exposed to increasingly challenging projects even at a young age if they demonstrate their capacity.

“We should not wait to promote good talent if we want to avoid the generational gap we talked about. I really believe that as an employee, as a young engineer, when you feel that you have your manager’s trust and that trust is pulling your career up, it’s really addictive.

“But also, it’s very important that we create a respectful, motivating and inspirational working environment where everybody feels that she or he is an integral part of the team. We may have the best jobs, the best salary, the best projects, but if we don’t have a good working atmosphere, we will lose people.”

In his spare time, Arpin is a keen marathon runner. It’s an apt analogy for a career in tailings engineering because, if you have the skills, the ambition and a passion for the subject, it can offer a very rewarding and long-term career path.

“One of our most senior engineers has been with the company for 41 years — his whole career,” Arpin said. “We have another who recently retired after 45 years in tailings management. I think the final word on this... it’s about passion.

“The mining industry is a great place to work. And it’s a really technological, state-of-the-art industry, despite what people may think. It’s clear to me that it’s a very interesting career path for young people.”

This Year's Iron Ore Report Looks Much Better Than Many Expected

High prices and a tight market could extend the rally well into 2022

By Anton Lof and Olof Lof

During 2019, the fundamentals of the steel market weakened considerably. The OECD (Steel Market Developments Q2 2020) cited weakening global economic activity, uncertain prospects for steel demand growth, the upturn in new capacity investments and excess capacity as some of the reasons.

Despite this, according to the World Steel Association (WSA), world crude steel production grew to 1.869 billion metric tons (mt) in 2019, a new global all-time high. This is an increase of 3% over 2018, and the fourth consecutive year of growth.

There were, however, significant differences across regions. Chinese crude steel production increased by 76 million mt in 2019, an increase of 8.3%, compared to an increase by 5.6% in 2018. At 996 million mt, China continues to be, by far, the largest producer, accounting for 53% of total crude steel produced. India, the second-largest producer with an output of 111 million mt of crude steel in 2019, only accounts for 6% of global steel production. There are six countries with national production of more than 70 million mt of crude steel in 2019 (See table 1). These countries together accounted for 77% of global production.

According to the OECD, global steelmaking capacity increased slightly in 2019, the first time since 2014 that net capacity has increased. The current global



Iron ore production for 2018 (million mt). Source: RMG Consulting 2020

steelmaking capacity at the end of 2019 is 2.363 billion mt. This represents an increase of around 1.5% from the end of 2018. Most of the capacity additions were located in Asia, where an additional 30 million mt of capacity came on stream. Also, companies in the Middle East (2.8 million mt), Africa (2.4 million mt), the CIS (1.5 million mt) and Europe (700,000 mt) added new capacity.

The gap between capacity and production did, however, continue to narrow over 2019. Production increased more than capacity. Using the OECD figures for capacity and the end of the year, WSA production figures, gives the global capacity utilization of 79% in 2019, up from 78% in 2018. This is, in fact, the highest utilization rate during the last 20 years, and at its low, in 2009, it was only 61%.

There are, however, several projects that will potentially add to the steelmaking capacity over the years 2020-2022. According to the OECD (Latest Developments in Steelmaking Capacity 2020), some 58 million mt of steelmaking capacity is under construction. While an additional 20 million mt is in the planning stage for a possible startup sometime prior to 2022.

China added some 24 million mt in capacity during 2019, but since 2015, capacity has fallen by 63 million mt.

The Chinese government reported that closure of capacity, especially older and less efficient plants, are going according to plan. Targets for reduced capacity and increased closures are also being revised upward, with the Hebei province leading the way.

The global steel demand recovery from early 2016 supported rising prices. A peak was reached in early 2018 from which prices have retracted. At the end of 2019, flat steel prices, according to the OECD, was 13% lower than at the start of the year and rebar prices were down 9%.

Prices for the key steelmaking raw materials (iron ore, coking coal and scrap) have followed divergent trajectories in 2019. While iron ore prices increased by 32% during the year, coking coal prices decreased by 15% and steel scrap prices fell by 17%.

Iron Ore Production

Global output of iron ore decreased by a modest 0.3% to 2.346 billion mt in 2019. The decrease is almost exclusively related to the fall in production in Brazil related to both the late dam disasters and COVID-19 restrictions. Brazil saw its production decrease by 58 million mt in 2019 compared to the year before, down 13%. Most other larger producing countries saw increases in production, however modest.

	Rank	2019 Mt	% of total
China	1	996.3	53.0%
India	2	111.2	6.0%
Japan	3	99.3	5.3%
USA	4	87.8	4.7%
Russia	5	71.9	3.8%
South Korea	6	71.4	3.8%
Top 6		1,437.9	77.0%
Total		1,868.8	100%

Source: RMG Consulting 2020.

Table 1 — Top steel-producing countries.

Australia remains the leader, producing 40% of all iron ore worldwide. Brazil accounts for 17% of global production. During 2019, Australia added some 11 million mt to its output, an increase of 1.2% to 919 million mt.

In Asia, most producing countries experienced growing production. India, for example, increased iron ore production by 14% and reached 233 million mt. Also, Iran increased production, up 11% to 61 million mt as well as China. Chinese iron ore production grew 3.3 million mt to 241.3 million mt in 2019.

In Europe, including the CIS, production increased by 2.4% in 2019, up to 231 million mt. African production was stable at 92 million mt. Output by the two major African producing countries, South Africa and Mauritania, both declined, the former by 5.1% and the latter by 2%.

Iron Ore Trade

Global iron ore exports decreased by 1.7% in 2019. This is the second year in a row that exports are decreasing. World total iron ore exports have increased roughly 43% during the last 10 years and amounted to 1.531 billion mt in 2019 compared to 1.558 billion mt in 2018. Australia is by far the largest exporter of iron ore with a market share of 55%, an increase of one percentage point from last year. Exports from Australia continued to increase during 2019, reaching 836 million mt, up 0.2%. The second largest exporter, Brazil has a market share of 22%, a decrease of three percentage points compared to last year. Brazilian exports fell by 13% in 2019 and reached 340 million mt, as discussed earlier, on account of closures related to the dam disasters and COVID-19.

South Africa exported 67 million mt of iron ore in 2019, which makes it the third largest exporter, Canada with 52 million mt is fourth and Ukraine at 39 million mt is fifth. Together, the five most important iron ore exporting countries accounted for 87% of total exports in 2019, down from 88% in 2018.

Among the larger producing countries, India's exports increased the most, by 69% in 2019 reaching 31 million mt. At the same time, imports came down by 87%. India, which seemed to be on its way to become a net importer of iron ore, has turned around and produced iron ore is now enough to satisfy both an increase in exports and an increase in steel production.

China alone accounts for 69% of total imports. During 2019, the country's imports of iron ore increased 0.4%. While minor, this is an increase compared to last year's decrease. During 2019, China also increased its iron ore production, but import dependency is still some 82%, the same as last year's figure. All other regions experienced decreases in imports during 2019.

Seaborne iron ore trade in 2019 decreased by 1.6% to 1.471 billion mt. The main reason being the drop in exports of almost 50 million mt by Brazil and Vale.

Iron Ore Pellets

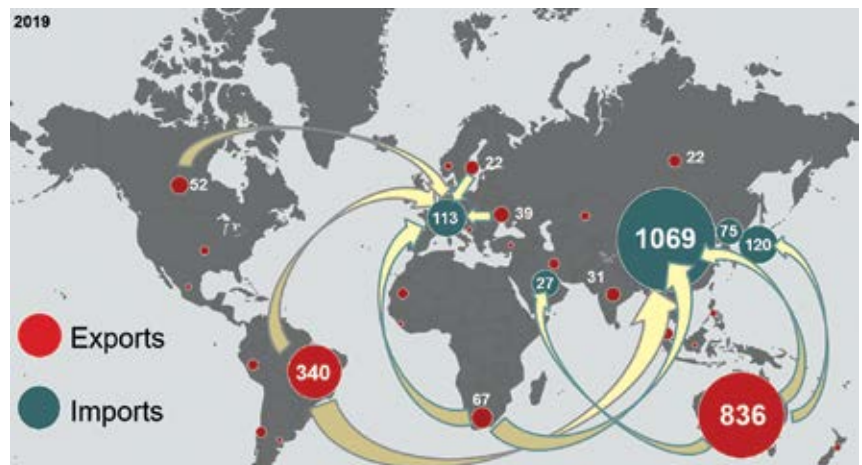
Global production of pellets in 2019 increased to 501 million mt, up 3% compared to 2018. Exports of pellets fell in 2019 and reached 134 million mt, down 5.1%. The largest iron ore pellet exporters are in order: Brazil, Sweden, Canada, the Ukraine and Russia.

The share of pellets in total iron ore production has declined since the late 1990s when it ranged between 26%-27%. During the last couple of years, the share of production has been relatively stable at around 20%, and in 2019, it reached 21%. However, the Mariana dam failure and the subsequent closure of the Samarco production units have underlined the sensitivity of pellet demand to world market conditions and prices. In 2015, total production of pellets coming from Brazil was 63 million mt. In 2019, production was more or less cut in half and only reached 32 million mt. According to plan, Vale will restart production at the end of 2020, so there is potential for an increase in world production of pellets in the short term.

Iron Ore Prices

In 2018, iron ore prices were relatively stable. The price for ore 62% Fe CFR China, continued on the same level into late January 2019. The year-end 2018 iron ore price was \$69/mt and January 2019 ended around \$76/mt. However, on January 25, 2019, the Brumadinho tailings dam operated by Vale collapsed, killing at least 259 people. On the first day of February, the price increased by 14%, the highest change day-on-day recorded during 2019. The disaster initially pulled an estimated 90 million mt of capacity off the market. Gradually, Vale reopened its operations and closed-down capacity was reduced to 60 million mt. This was, however, enough to effectively push up the price of iron ore. From February 2019, the price took off and reached a peak in early July at around \$123/mt. The period with prices above \$120/mt was, however, short. Through August, the price dropped by 24%. During the latter part of 2019, the price stabilized and moved between \$80-\$95/mt. The price at year end was \$92/mt, an increase from the start of the year of 32%. The average price over 2019 was \$93/mt, an increase from 2018 (\$69/mt) of 33%.

The iron ore market has continued to be tight into 2020. According to the Department of Industry, Science, Energy and Resources in Australia, iron ore inventories are at near five-year lows. Supply disruptions in late 2019, such as cyclones in the Pilbara region of Western Australia and flooding in the south and east of Brazil, pushed prices higher. With the introduction of COVID-19 containment measures, further capacity has



Iron ore trade in 2018 (million mt). Source: RMG Consulting 2020

been curtailed at individual mine sites. The robust and consistent demand from China and disruptions of the supply of iron ore, mainly from Brazil, have forced iron ore prices to adjust to a tight sea-borne market and stay high even though the general economic climate remains uncertain. The iron ore prices, 62% Fe CFR China in mid-October 2020, was around \$122/mt, up 34% since the start of the year. The average price until mid-October 2020 is \$101/mt, an increase in average price of 8.5% compared to the average price of 2019.

The price premium for high-quality iron ore increased sharply during late 2018 as Chinese demand increased and high-quality ore supply from Brazil tightened. Subsequently, markets adjusted to use greater quantities of lower grade ore, with the price premium easing during 2019. The price spread between iron ore grades increased again around April 2020 amid a surge in demand for higher-grade ore, but has since abated somewhat.

Project Pipeline

In 2019, global production of iron ore fell by 6 million mt. However, most of the important iron ore producing countries increased their production, with the exclusion of Vale and the drop in Brazilian production of 58 million mt. These increases were not the result of new green field capacity coming on stream, but rather incremental growth in existing operations. Iron ore capacity has been relatively stable during the last three years with most of the capacity additions located in the two largest iron ore producing/exporting countries: Australia and Brazil. How-

ever, with the high prices seen recently, the industry will likely see an increase in exploration expenditure earmarked for iron ore. Further, some African projects have attracted renewed interest and some mines that were closed down have considered reopening.

In Brazil, during December 2019, Vale completed the physical works and startup of the CLN S11D project, the infrastructure project to support the S11D mine and the Northern System. Until 2022, the project will be in a ramp-up phase. This means the S11D mine that was completed in late 2016 now has reached full production capacity. The company also plans to increase production another 10 million mt/y within the Northern System. As of the end of the first half of 2020, the project is 25% completed and is expected to be finalized by the second half of 2022. Vale targets capacity of 400 million mt/y by increasing production across operations through debottlenecking and the restart of temporary closed operations. Further into the future, Vale envisions a capacity of 450 million mt/y. Also in Brazil, Anglo American's Minas-Rio mine in late December 2019 received necessary permits to finalize the stage 3 expansion that will take the mine to full capacity. The mine is expected to deliver 26.5 million mt/y. The Germano mine, operated by Samarco, closed since the Mariana

dam disaster in November 2015, is set to come on stream again in December 2020. The plan is to start operations at 8 million mt/y and increase production to 24 million mt/y during a ramp-up period that could extend over 10 years.

In Australia, iron ore projects account for more than AUD 40 billion (\$28.6 billion) of potential investment expenditure. There are currently some four committed projects as well as 12 projects labeled as in the feasibility stage and another 13 that have been publicly announced. However, there has been little progress in iron ore development projects over the past years. One of the few projects completed during 2019 was the refurbishment of the Koolan Island iron ore mine, owned by Mount Gibson, with a capacity of 4 million mt/y. There are a couple of large-scale projects under way. The Iron Bridge Magnetite Project, co-owned by Fortescue Metals Group (FMG), Formosa Steel and Baosteel, is progressing. The project is estimated to cost \$2.6 billion and have a capacity of 22 million mt/y of high-grade iron ore. The estimated start of operations is 2022. Another FMG project, Eliwana is set to commence production in December 2020 and have a capacity of 30

Company	1 st Half 2019	1 st Half 2020	% Increase
Rio Tinto	134.7	138.5	2.8%
Vale	137.4	127.2	-7.4%
BHP	118.7	126.7	6.7%
FMG	91.5	86.9	-5.0%
Anglo American	30.9	30.5	-1.3%
Arcelor	28.7	27.9	-2.8%
Metalloinvest	19.7	20.2	2.5%
NMDC	19.1	16.9	-11.5%
Metinvest	14.5	15.2	4.8%
CSN	19.0	13.4	-29.5%
LKAB	12.7	13.4	5.5%
Cleveland Cliffs	9.7	7.0	-27.8%
Total	637.0	624.0	-2.0%

Regions and major producing countries	2017	2018	2019
Sweden	27.2	27.5	29.1
Subtotal Europe (excluding CIS)	34.0	34.0	36.1
CIS	188.7	191.8	195.2
Subtotal Europe	222.7	225.8	231.3
Canada	50.3	52.8	58.5
USA	47.9	49.5	48.0
Brazil	435.5	448.0	389.6
Venezuela	6.6	4.0	2.6
Subtotal Americas	582.4	599.9	539.6
Mauritania	11.8	10.7	10.5
South Africa	74.8	74.3	70.5
Subtotal Africa	95.7	92.0	92.2
India	201.8	204.7	232.8
Subtotal Asia (excluding China)	308.0	285.7	320.0
China*	253.1	238.0	241.3
Subtotal Asia	561.1	523.7	561.3
Australia	885.4	907.8	918.7
Subtotal Oceania	889.4	911.3	922.0
World Total	2,351.3	2,352.7	2,346.4

*Chinese production adjusted to represent tonnage in which iron content is roughly equal to average content in the rest of the world.
Chinese ore production (unadjusted): 1,229.4 763.4 844.4
Source: RMG Consulting 2020

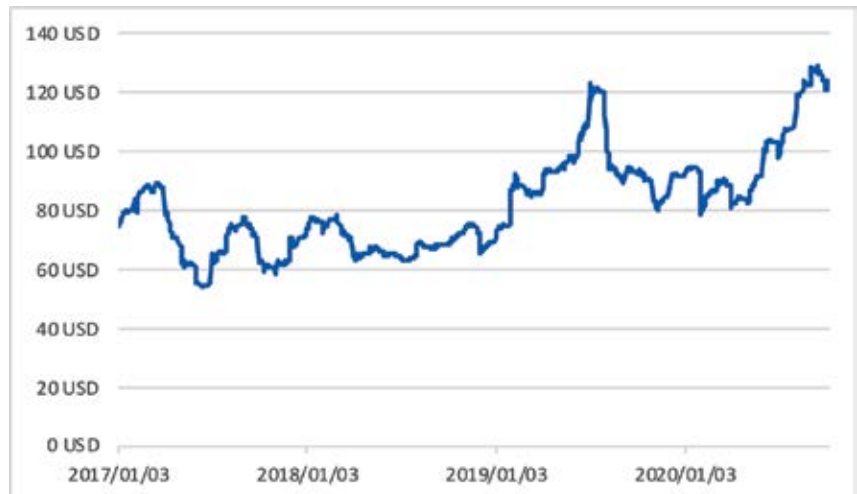
Vale's H1 2020 production suffers from COVID-19.

Australia produces nearly twice the amount of iron ore as the Americas.

million mt/y. Rio Tinto's Koodaideri project is planned to start production in late 2021 and have a capacity of 43 million mt/y. Further, the company is investing in West Angelas and the Robe Valley, with first ore expected in 2021. Investments are under way in the Greater Tom Price operations. All of Rio Tinto's investments are related to sustain current production capacities. Finally, BHP's South Flank mine is planned to replace existing production from the Yandi mine, with production starting in 2021 at a capacity of 80 million mt/y.

In Ukraine, Ferrexpo is adding 6 million mt/y of additional processing capacity, which will raise the raw ore capacity to 36 million mt/y and will further realize full capacity of pelletizers (12 million mt/y) in 2021. For the longer term, the company is presently studying potential for the increase of raw ore production capacity of 50% and to increase pellet plant capacity incrementally by 3 million mt/y.

In Africa, projects are slowly being revitalized. In Guinea, Simandou, one of the world's largest undeveloped projects, is slowly moving forward after several disputes and Rio Tinto failing to sell its remaining shares in block 3 and 4 to Chinalco. Rio Tinto stated that the company continues to work with joint-venture partners, Chinalco and the government of Guinea, to explore ways to optimize, develop and fund the world-class Simandou iron ore deposit and the trans-Guinean infrastructure needed to support the mine. However, no timelines were discussed. "Simandou will happen, with or without Rio Tinto's involvement" Rio Tinto's CEO J-S Jacques said. During late 2019, Simandou blocks 1 and 2 was auctioned. The winning bid came from the SMB-Winning consortium, formed by the Singaporean shipowner Winning Shipping, the Chinese aluminum producer Shandong Weiqiao, the Yantai Port group, as well as the Guinean transport and logistics company United Mining Supply. The winning bid was for \$15 billion. Other bidders included FMG in an attempt to go outside Australia. Also close by, on the border to Liberia, are the Zogota and Nimba projects. On September 5, 2019, High Power Exploration, led by Robert Friedland, founder of Ivanhoe Mines Ltd., acquired the world-class Nimba iron ore deposit in the Republic of Guinea. The company is planning to bring a starter mine with the



Iron prices should remain above \$100/mt for the near term.

capacity of 1-5 million mt/y into production as quickly as possible while completing feasibility studies for an operation of at least 20 million mt/y. All the projects in Guinea are located in the mountainous region in the north of the country and demand the construction of a new railway, a quite complicated infrastructural project.

In the Republic of the Congo, the Zanaga project, a joint venture between Zanaga Iron Ore and Glencore, is continuing. The projected mine will produce 12 million mt/y in the first stage and raising output to 30 million mt/y in a second stage. An early production project with a capacity of 1 million mt/y is also under consideration, however, no timelines were presented. Also, in the Republic of the Congo, the Sapro group exported its first tonnages in Q1 2019 a shipment of 23,000 mt of iron ore. The company, which plans to produce 12 million mt/y for export, mainly to China, seems to have failed to ship any more material. The total export of the Republic of the Congo did not amount to more than 19,000 mt, according to Chinese import statistics.

The Scully mine in Canada, previously owned and closed down by Cleveland Cliffs in 2014, was restarted by its new owner Tacora Resources Inc. The company announced its first delivery in August 2019 and seems to be on its way to achieve nameplate capacity of 6-6.5 million mt/y. The Sydvaranger mine in northern Norway, another example of a closed down mine getting new attention, received authorization from authorities in mid-2019 for the resumption of operations. The mine targeted iron ore concentrate shipments in

2020, however, startup of production has been delayed until sometime in 2021.

There are also examples of idling of capacity due to high operating costs, for example, U.S. Steel's Keetac operations.

While there are quite a few projects in the pipeline, the main additions to production in the near term will probably come from Brazil and Vale as well as Australia with FMG, BHP and Rio, all adding capacities. Most of the other projects are either small or further out in time. All in all, the market seems likely to enter another period of overcapacity. This could push or stall some of the early-phase projects in the pipeline. Still, the project pipeline as it looks like in mid-2020, could indeed be the foundation for an oversupplied market during the next couple of years.

Corporate Concentration

Corporate concentration in the iron ore industry has remained fairly constant over the last couple of years. In 2019, the 10 largest companies controlled 58% of global production, a decrease from 2018 (60%), but in line with the 2017 (58%) and the 2016 (58%) numbers. The decrease is mostly related to the fall in production for Vale. The company decreased its production by 83 million mt in 2019, compared to 2018, down 21%. However, Rio Tinto and BHP Billiton, the second and third most important iron ore producing companies, reduced their production by 3.4% and 0.7%, respectively. This was partly compensated by large increases from FMG and Anglo American.

The 2005-2008 trend of decreasing concentration, due to swift production

Company	Country	Production 2019 (Mt)	% of World	Production 2018 (Mt)	Rank 2018
1 Vale	Brazil	302.4	12.9%	385.0	1
2 Rio Tinto	U.K.	281.2	12.0%	291.0	2
3 BHP	Australia	272.0	11.6%	274.0	3
4 Fortescue	Australia	182.8	7.8%	166.0	4
5 Hancock*	Australia	79.1	3.4%	76.0	5
6 Anglo American	U.K.	65.5	2.8%	47.0	7
7 Arcelor	U.K.	57.1	2.4%	59.0	6
8 NMDC+Odisha	India	45.3	1.9%	43.0	8
9 Metalloinvest	Russia	40.2	1.7%	40.0	9
10 CSN	Brazil	32.1	1.4%	28.0	10
Total Top 10 Companies		1,357.8	57.9%	1,409.0	
Total World		2,346.4	100.0%	2,352.7	

**Roy Hill mine production is estimated*

In 2019, the combined iron ore output from the top three miners represented 37% of global capacity.

increases by many small- and medium-sized producers was reversed in 2009 when the major producers got their large expansion programs up and running. Since then, industry concentration has increased slowly but steadily, apart from 2019. While the “Big 3” iron ore mining companies (Vale, Rio Tinto and BHP) earlier have increased their control over total world iron ore production, it now seems like they have lost out somewhat to the other large producers. In 2018, the Big 3 combined control reached 40%. In 2019, this had decreased to 37%.

Vale, the Brazilian-based major mining company, despite a drastic fall in output during 2019, remains the world’s largest iron ore producer, with 302 million mt of iron ore produced in 2019, down from 385 million mt in 2018. All of Vale’s mines are in Brazil and its market share decreased from 16% in 2018 to 13% in 2019. Vale’s market share peaked already in 2007 at 19%. Rio Tinto has been the second-largest producer since 2016, when it overtook BHP and regained its traditional second rank. Rio Tinto produced 281 million mt in 2019, down from 291 million mt the year before. Rio Tinto has a market share of 12%, a slight decrease compared to 2018. Most of Rio Tinto’s mines are located in the Pilbara region in Australia. In addition, the company controls the Iron Ore Co. of Canada with mines in Labrador. The market share of BHP stayed at 12% and production reached 272 million mt in 2019. Except for the Samarco joint venture in Brazil together with Vale (50/50), which has not been producing since 2015, all of BHP’s mines are in Western Australia.

Hancock Prospecting, the privately owned emerging Australian iron ore giant, controlled by Gina Rinehart, has grown rapidly during the last couple of years. The company owns the Hope Downs mine in Western Australia together with Rio Tinto, the Roy Hill mine and in December 2018, the company acquired Australian miner Atlas Iron to further boost its iron ore production. Production, which began in 2016 at the Roy Hill mine, has catapulted Hancock into the fifth position among the world’s largest iron ore miners.

The measurement of corporate control at the production stage underestimates the real concentration of the iron ore sector, especially by the three largest companies. Large portions of total output do not enter the market, but are produced at captive mines or mines that have a protected or restricted market. The corporate concentration, if measured by the share of the major companies in the global seaborne trade, is considerably higher. Vale alone controls 21% of the total world market for seaborne iron ore trade, and the three largest companies, in 2019, controlled 58%, a decrease from 64% in 2018. Among the top 10 producers, the six largest sell almost all their iron ore on the open market, the other four all produce steel from a large proportion of their iron ore production. These top six accounted for more than 80% of the market in 2019.

China increased its domestic production during 2019 of raw iron ore. In 2020 though, production has been stable and increased a modest 2.6% from January to August, compared to the same period last year. As the price has remained at a

high level during the first half of 2020, additional marginal independent producers might be able to enter the market and push corporate concentration down. However, Vale is on track to restart closed-down operations. Should the company be able to reach its old production figures of 2018, a reversal of the decline in 2019 could happen. Considering that Vale is planning for a 400-million-mt/y capacity, a future scenario with a higher corporate concentration is highly likely. Most probably though, for 2020, corporate concentration will only change marginally. How much will mostly depend on Vales’ ability to restore production. The company has communicated a production guidance of between 310-330 million mt for 2020 with a higher probability of production ending up in the lower end of this interval. This would mean a relatively stable production compared to 2019 and, consequently, relatively stable corporate concentration for 2020 compared to 2019.

Market Outlook

Global economic growth in 2019 reached 2.8% according to the IMF October World Economic Outlook. The IMF forecasts a decline of 4.4% in 2020 followed by a 5.2% growth in 2021. While this is a more negative forecast compared to the April outlook, it is actually 0.8 percentage better than anticipated in June 2020. The latest revision reflects better-than-anticipated second-quarter developments and indications of a stronger than expected recovery in the third quarter. If the projections come true, the global economy in 2021 will have seen a modest growth of 0.6% over 2019. The uncertainties, IMF pointed out, are unusually large in this stage because of the pandemic. With a potential second wave of COVID-19 and related forced shutdowns and impairments to the global economy, much could happen between now and the end of the year.

During 2019, world crude steel production increased by 3%. For the first eight months of 2020, global steel production declined 4.2% compared to the same period last year. China alone accounted for roughly 58% of the crude steel production globally during the first months of 2020. The country’s production of crude steel grew by 3.7% during the period. However, Chinese production will most likely taper off during the winter months with governmental restrictions on emissions. Total

growth over the year is hence likely to be lower than so far this year.

The WSA's Short Range Outlook June 2020 for world steel use anticipates a decrease in world steel demand by 6.4% in 2020, followed by an increase of 3.8% in 2021. China, on which so much depends, is forecast to increase its steel demand by 1% in 2020 and no growth in 2021.

Something that should negatively impact the growth potential for steel demand is China's move toward a lower GDP growth with a society where consumption rather than investments is the driving force of economic activities. Further, globally, the scrap share of the steel burden is increasing as more and more steel becomes available for recycling. Analyzing the numbers from China, this trend is increasing rapidly. No doubt this will limit the demand growth for virgin units of iron ore into the future.

For the period January to August 2020, the combined global pig iron and DRI production decreased compared with the same period last year, by 3.1%. Further, for the first six months of 2020, 12 major companies, which reported quarterly

figures produced 624 million mt. This represents a decline of 2% compared to the same period last year. Vale shows the largest decline in absolute numbers with 10 million mt, down 7.4%. CSN, another Brazilian miner, cut production by 30% in the first half of 2020 compared to 2019. As a result, Brazilian exports for the period January-August 2020 decreased by 8.6% compared to the same period in 2019. Chinese imports during the period January-August 2020 increased by 11%, compared to the same period of 2019. Chinese imports were 760 million mt for the first 8 months of 2020, equal to 1.140 billion mt on an annualized rate. Chinese production of raw iron ore for the first 8 months of 2020 increased compared to the same period last year with 2.6%. As a result, the market has continued to be tight during 2020, and prices have stayed high.

There is little indication of increased supply for the end of 2020 and the main risk to the iron ore price is thus falling demand, mainly from China. Considering the latest development in the seaborne market, it is likely that a slight fall in demand will take place and consequently,

prices will fall back. However, considering the current situation, iron ore prices, 62% Fe CFR China, below \$100/mt during 2020 seems unlikely.

With a modest growth in steel for 2021 compared to 2019 and an increased scrap ratio, demand for iron ore will be subdued. Combined with the fact that iron ore production capacity will most likely increase faster than iron ore demand, as discussed, the spot iron ore 62% Fe price will be under pressure. An iron ore price somewhere around \$80/mt is more realistic considering the bleak circumstances for 2021. However, the iron ore market is balanced. Should steel demand and steel production surprise to the upside and some of the planned new mine capacity fail to materialize the surplus could turn into a deficit fairly quickly and the price trajectory of 2020 could be repeated yet again in 2021.

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Drilling Trends Demand Tougher Bits

Suppliers are building more powerful rigs. Customers want more drillhole footage. The industry is moving toward autonomous drilling. Can new rock tools meet these challenges?

By Russell A. Carter, Contributing Editor



Reflecting an emerging trend among rock tool suppliers, Epiroc designs its new COP M series DTH bits and hammers to be 25% more compact and 30% lighter than previous versions.

The mining industry is renowned for the size of its operations and machines — rope shovels that load 120-ton bits of dirt and rock into haul trucks bigger than houses, bulldozers that can push mountains of material in a single pass, and crushers that break boulders into softball-sized chunks. So, it's ironic that the productivity of these giant machines often depends on the performance of relatively small components. For example, when it comes to exploration, development or production drilling with mining-class rigs, all of the machine's power, weight and intelligence is focused on a tool that, even in its largest configurations, is no bigger than a waste basket: the drill bit.

With the possible exception of ground-engaging parts such as shovel and loader bucket teeth, percussion and rotary drill bits have the toughest job of

any mining tool — and they're designed for the task, cast from tough steel alloys and capped with some of the hardest materials available. But, however hard the job presently is for bits and drill rods, it's likely to get even tougher. New drill rigs offer higher rotational torque and pull-down force that can increase stress on drill string components. Financial strains could tempt some drilling contractors and mine operators to get longer life from consumables such as bits by running them until they're worn beyond the point of minimum efficiency. And customers are asking contractors to drill longer holes. A drilling contractor recently completed a 3,467-m-long, flat-angle diamond drill hole at Osisko Mining's Discovery 1 project earlier this year — claimed to be the longest hole of its type ever drilled in Canada.

Exploration drilling can cost more than \$200 per meter, depending on a number of factors not the least of which is the expertise of the drill crew. However, disruptions in the mining workforce due to pandemic-related layoffs, furloughs or operational suspensions also bring the possibility that experienced drillers may never return to their jobs, either from failure to find suitable work or by simply walking away to find employment in another sector.

Denis Larocque, president and CEO of Major Drilling Group — the company that drilled the record-breaking long hole mentioned above — recently told S&P Global Market Intelligence that when pandemic-related problems recede and global exploration drilling rebounds, a key issue will be labor. “Rigs are really not the problem,” he said, but crew training could be a concern as some job skills take years to develop. Over time, experienced drill operators learn to listen and assess what is happening down the hole in order to make adjustments for achieving optimal penetration rates while preserving machine health and steering clear of avoidable drill-string problems.

Jimmy Barrieau, global EHS director at Boart Longyear, said, “These challenges are not new to the drilling industry, but the pandemic has intensified the problems.

“Several indicators and trends have identified the need to improve and make more efficient field and driller level training. Our safety statistics have shown that new hires and employees with less than one year of service have a disproportionately higher injury rate than more experienced employees. That creates challenges to delivering high quality, safe and productive drilling services to clients.

“Our focus has been on developing an approach that will better transition employees into their role or job function and provide direction and insight on what's required to transition to the next level. Our

Competency Training Program has been developed to do just that.

“There are several data points that provide a strong business case for integrating a comprehensive competency program — safety, productivity, efficiency, reduce attrition or employee turnover,” he continued. “How we train plays a critical role in all those points. Providing additional organization and structure, in combination with our existing virtual and eLearning solutions, will greatly enhance our training efforts with usable tools that work well for our business.”

He further explained that “the equipment challenge is to automate and create a drill site with ‘no hands on steel.’ Are we there yet? No, but the effort and engineering are catching up with the demands of industry. We are using Mag-Grip Rod Lifters to assist crews when moving drill tubing, casing and tubes. This is one small tool that can improve the ergonomics of drill site manual handling. Our LF160 and Freedom Loader rig package is an example of moving in the right direction. We are testing prototypes that fully automate an underground drill rig, with aspirations to have field trials completed in 2021. This technology would, to an extent, remove the human element in drilling and extracting a core sample.”

Other new products, such as Imdex’s Xtracta system, help make core drilling safer for crews. With Xtracta, the driller can inspect and/or change the bit/reamer each time the core is pulled, without need to pull the rods to change bits. According to the company, risk of injury is significantly reduced as the requirement to pull rods is no longer influenced by downhole conditions or typical bit wear.

Meanwhile, rock-tool suppliers are fully cognizant that safety, reliability and longevity will be increasingly critical factors in market acceptance of their products, and they have been focusing on making bits that are lighter, more compact and long-lasting — with longer service life gaining even more importance as the industry moves toward semiautonomous or fully autonomous, unattended drilling operations. One indication of the direction in which the industry is heading is a recent announcement by Brisbane, Australia-based Universal Field Robots that it answered a call for help from the industry by designing an animated 3D model of an autonomous system to re-

move and replace heavy tricone blasting bits in the field. The concept was in response to a developer challenge issued by Chilean copper producer Antofagasta for eliminating manual changeouts of the hard-to-handle, 80-kg bits and thus reduce the risk of injury to workers.

UFR Managing Director Jeff Sterling explained: “[We build] robotic machines for various mine site tasks that can be operated remotely, with assisted automation and fully autonomously. The unit that would be suitable for this application is our E20C, based on a Caterpillar 2-ton excavator, upon which we integrate robotics. The unit is diesel powered with hydraulic controls and a quick hitch. The robotic features include a GUI interface, radio joystick control, emergency stop, a safety system with safety controller, mode indication lights, vision sensors, position sensors, remote video camera unit, radio communications and GPS positioning.

“The E20C will be fitted with a tool attachment for breaking and handling the tricones. The purpose designed attachment for this application will allow the remote or autonomous handling of the bit, with no people needed to be near operations.”

The concept, according to the company, is currently being evaluated by Antofagasta, and other mining companies also have expressed interest in it.

At first glance, crew deficiencies might be seen as a problem mainly for drilling contractors and smaller mining companies that don’t have the deep pockets needed to install and maintain semi- or fully autonomous systems throughout their rig fleets. But that doesn’t appear to be the case. According to Epiroc, for example, most of the drills they’re now delivering are immediately capable of autonomous operations if the customer desires, and overall, more than 600 of its machines currently at work around the world are similarly equipped, with not just major producers, but drilling contractors as well showing rising interest in the technology. Apart from order-book considerations, the trend is welcomed by drill OEMs for another reason. With a wider variety of applications to draw from, they can better refine their productivity models using the increased volume of data collected from autonomous-rig instrumentation.

However, whether based on computer-assisted modeling or years of experi-

ence in the field, a decision about when to replace a drill bit generally boils down to an assessment of performance (how quickly is it cutting the rock?) versus age (how much more service can we get out of this bit?) Leading industry suppliers such as Epiroc, Sandvik, Varel (which recently changed its name to Terelion), Boart Longyear, Brunner & Lay, Rockmore and Robit are in the business of developing products aimed at making that decision easier and less frequent for their customers.

What’s New

Although 2019 was an up-and-down year for mining, producers and industry suppliers will likely look back upon it fondly in comparison with 2020, when the effects of a global pandemic turned what had been solid economic terra firma into quicksand for many companies and their employees. Always technically innovative, rock tool providers have had to become both logistically and digitally innovative as well in order to comply with regulations and adapt to business-related limitations imposed by public health policies around the world.

The new reality for suppliers encompasses everything from altered supply chains to delayed field-testing of future products, along with reduced business travel and increased reliance on virtual site visits, AR-enhanced diagnostic consultations and video-based training. However, suppliers still have the security of a robust product pipeline that was active in 2019, generated a few product introductions earlier this year and has some soon-to-be-announced solutions waiting in the wings for a 2021 appearance. Here’s an update on the most recent developments.

Epiroc announced several bit-family introductions over the past year or so. The company’s unveiling of their new Epsilon² premium tricone bit was highlighted by the claim that this new product will allow users to possibly double the drilling distance they obtain from a bit before reaching the disposal point. The new bit’s patented features, said Epiroc, will greatly improve productivity through extended bit life and a faster rate of penetration.

The company said Epsilon² air-bearing bits had been tested thoroughly in the field, with results indicating an average of more than 60% longer distance drilled

before bit discard compared with the previous Epsilon generation.

"[Bearing degradation] was long a common cause of bit failure, forcing customers to accept a slower ROP and a shorter service life than necessary. Either the bearings would corrode due to moisture from water injection for dust suppression or overheat by friction," said Bahadır Ergener, product line manager, (PLM) Rotary. Two patented features included in the Epsilon² bits are designed to solve the problem. One feature called Tornado provides a more effective way to provide cooling air to the bearing. The other, called Torrent AWS, removes 95% or more of the moisture from the cooling air and therefore reduces parts corrosion. The two features, according to Epiroc, combine to increase bearing air flow by 60% and reduce cone erosion by 59%, doubling bearing life.

Epiroc also noted that the Epsilon² bits include NOPS, a patented feature licensed from Baker Hughes that optimizes the direction of the nozzles used for water injection. This helps to remove cuttings and clean the rock face more efficiently,

thereby increasing the rate of penetration (ROP) and extending the life of the bit's cutting structure.

The Epsilon² line includes sizes ranging in diameter from 6-3/4 to 16 in. (171 to 406 mm), and with specific insert configurations for soft, medium, hard and very hard rock types.

Epiroc also expanded its Powerbit line to include versions for underground drilling. Powerbit Underground bits outperformed standard bits in comprehensive testing, registering an average 37% more drill meters before discard, according to Johan Thenór, product line manager, tophammer products at Epiroc. The first Powerbit Underground bits to enter the market are 45-mm-diameter versions, to be followed by 48 mm, 51 mm and additional sizes over time.

The Powerbit Underground line, according to Epiroc, is its answer to market demand for a bit that matches the high drilling speeds possible with new, stronger rigs and rock drills. The bit's design features optimized flushing capacity, tougher steel alloy and the innovative Trubbnos trapezoid-shaped but-

ton design that is claimed to increase penetration rate and service life compared with conventional buttons. Versions with conventional round buttons also are available.

Epiroc said it developed the new button shape to overcome the traditional compromise of bit design that dictates larger carbide buttons provide more bit wear life but reduce the penetration rate. Trubbnos buttons, according to the company, offer several benefits. They increase radial contact area with the hole wall, providing the bit with more carbide volume to wear down before reaching minimum allowable bit size. The increased contact area also allows the hole wall to push harder against the button, helping the button to withstand the bending moment created by the impact forces. And, they decrease frontal contact area with the hole bottom, reducing rock penetration resistance and increasing the drilling speed.

Epiroc also unveiled its new COP M-series DTH hammer lineup in 2019, comprising a family of bits that the company claims are faster, lighter, more ser-

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vice friendly and longer lasting. The new range of DTH bits feature a unique solid shank that further enhances penetration rate and durability.

According to the company, COP M-series hammers can be quickly and easily adjusted to different compressor air pressures and air volumes by simply exchanging a few parts. “The adjustable feature of the COP M-series hammers comes in handy when mining companies run different size rigs and operate mines at different altitudes. Our customers can stock fewer hammer variants, allowing reduced stocks and less capital employed,” said Fredrik Gransell, product line manager, DTH Equipment. He noted that all of the COP M-series hammers — which are available in 6-, 7- and 8-in. sizes — show significant improvements in penetration rate and service life, but the M7 version has been particularly successful as it “bridges a known productivity gap between 6- and 8-in. hammers.”

Epiroc pointed out that a new, patented air cycle design on the COP M-series models replaces one that has been dominant on the market for more than



Sandvik's line of PowerCarbide products now includes seven grades that offer unique combinations of strength, hardness, toughness and wear resistance, the company says.

40 years, enabling a considerably faster cycle and resulting in a shorter, lighter and faster hammer. According to the company, the new hammers are 25% more compact and 30% lighter than previous models, making them safer and easier to handle.

Sandvik's Innovation in Mining virtual event, held in late September, served as a showcase for the company's newest products, such as its PowerCarbide line,

Alpha 360 tool system and Speedy bits, as well as an opportunity to remind the industry that it will introduce new products in 2021.

Sandvik markets the PowerCarbide family as a platform that provides users a range of options for customizing bit characteristics to meet specific drilling conditions. Need a bit that will perform well in abrasive rock? PowerCarbide Gradient grades could provide a 20%-30%

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improvement, suggested Robert Grandin, product manager, Tophammer Tools, Underground Applications, while self-hardening PowerCarbide grades could offer significantly improved results in a variety of ground conditions.

Xueying Hai, product manager, DTH Bits, said testing had confirmed that PowerCarbide bits could double previous bit life. She also pointed to a combination of corporate capabilities that, taken together, offer an attractive choice for drilling customers. Sandvik has in-house R&D resources for carbide development, and can easily coordinate that with its hammer and bit design efforts to produce highly effective products. In addition, it claims to be the only major supplier to offer more than just a standard line of carbide choices. Hai also noted that Sandvik can provide service advantages such as rebuild kits that give hammers second or third lives.

The company's PowerCarbide-equipped Speedy bits are claimed to provide 10% faster drilling speed compared to standard bits with ballistic buttons — saving users up to an hour per day per rig. Sandvik said the bits' patented, elevated front breaks rock at two levels and improves the flushing flow, while large sludge grooves enable quick removal of large cuttings. Speedy bits come in three sizes: 45, 48 and 51 mm.

Looking ahead, Sandvik plans to release several new products in the coming year: a new sealed-bearing rotary drill bit and shock absorber, and a new tophammer tool system. Few details are available for the new bit, to be labeled the Charger RR450, but Sandvik's Carsten Mijic, product line manager, Rotary Tools, commented that the company development efforts for its rotary bit future portfolio focus on the use of PowerCarbide for longer life and higher performance; attention to the ongoing need to improve steel performance as well as development of harder materials to protect the steel; and advanced computer design methods to improve flow and optimize carbide and steel arrangements — all intent on giving

customers the longest possible interval between bit changes.

Sandvik also said the innovative design of its new RP550 shock absorber will enable it to be maintenance free, while featuring an entirely new safety coupling that locks the thread connection and makes operation significantly safer.

In the digital realm, the company's My Rock Tools Track and My Rock Tools Drill join its Rock Tools Digital Services offerings. Historically, key customer data such as cost per meter, number of used tools and rock tool performance has been captured manually. Track makes this entire process digital, allowing for quick and easy data input and constant up to date monitoring of drilling operations. This capability, according to Sandvik, facilitates real-time analytics and problem solving, on-site or off.

"Track helps us improve our service offering globally and is a powerful tool in all aspects of our contract support — productivity enhancements and logistics, for example," explained Rickard Andreasson, commercial manager, Rock Tools Division.

He also noted that Track could reduce the frequency of travel for on-site studies or consultations, an important consideration in a pandemic-constrained business climate.

Track is initially being introduced in Australia, South Africa, Sweden, Canada and the United States. More than two dozen customers have started using it and have reported favorable results, according to the company.

My Rock Tools Drill is an interactive simulator that is aimed at helping Sandvik's customers achieve a deeper understanding of how correct settings impact both rock tool life and performance. It is available for tophammer, down-the-hole and rotary applications and demonstrates how to maximize productivity in different ground conditions.

Robit introduced a family of diamond button bits for tophammer drilling, making the bits available on the market late in 2019, initially in 89-mm and 102-

mm sizes. The first customer to use the new bits was Agnico Eagle's Kittilä mine in Finland, said Kimmo Kangas, Robit's sales manager.

"Traditionally, bits have had hard metal buttons, but on the new Robit Diamond Button Series bits the buttons have an industrial diamond coating, which lasts many times longer than a regular bit and does not need to be sharpened," said Robit R&D engineer and materials specialist Niko Ojala.

The diamond coating "has several layers, which ensures adherence and enables the diamond bit to withstand the shocks and heat fluctuations of tophammer drilling," Ojala explained. The company had previously used the diamond coating with success on bits used in the oil and gas sector, and test results showed the new bits can stand up to drilling in hard rock as well.

"When drilling hard granite, you may have to remove a traditional hard metal button bit after 80 meters, for example, while with the diamond button bit you can drill nearly 1 kilometer. And as the diamond buttons do not, in practice, wear out, their penetrating ability does not deteriorate like regular hard metal buttons. Drilling speed therefore remains the same throughout the bit's tour of duty.

"Similarly, the diameter of the borehole does not decrease as the bit ages, resulting in a more consistent and predictable end result in production drilling. The longer change interval offered by the bit saves time and is particularly important for remote-controlled drill rigs in fully automated mining environments," he said.

Bit manufacturer Varel Mining and Industrial, a wholly owned subsidiary of Sandvik Group, recently changed its name to **Terelion**. The newly branded entity will continue to design and manufacture drill bits and complementary products for blasthole drilling.

The company's latest product offering is the line of Warrior DTH hammers and bits, initially available in 6-in. hammer size and corresponding bit combinations. The Warrior hammers, according to Terelion, feature an optimized air cycle that has lower air consumption, thus providing a lower cost of operation. Bits are available in three face configurations — concave, flat and convex — and standard, premium or ultra-premium carbide grades.



Terelion says its Warrior DTH hammers benefit from comprehensive design simulation analysis that provides an optimized air cycle with reduced air consumption.



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Slope Monitoring Tech Trends Spread Safety

Increasing integration and ease-of-use define the latest slope stability solutions, making them easier and potentially cheaper to adopt

By Jesse Morton, Technical Writer



The walls are coming down. The newest slope stability solutions offer greater integration, making them easier to adopt and deploy. Above, dewatering effects on highwall stability can be modelled in the new, integrated GeoStudio Core. (Photo: Seequent)

One obvious trend in the latest slope stability solutions is improved integration. The newest tech can now either easily integrate or be integrated. Since integration is a prerequisite for the digital mine, the trend should, in theory, nudge more miners in that direction.

Another quality the newer solutions share is ease-of-use. Their operation is described as intuitive, their interfaces as friendly, and training as minimal.

Both trends suggest that, at least in theory, future solutions will be easier and less expensive to adopt. More mines will be able to deploy more solutions that immediately detect and, increasingly, predict rock movement. Thus, most importantly, they bode well for the future of mine safety in general.

Integrated Solutions Speed Alerts

Hexagon Mining and sister company IDS GeoRadar announced upgrades to HxGN MineProtect Collision Avoidance System

(CAS) and IBIS Guardian radar monitoring software that allow the two to communicate and drastically cut the time between slope stability risk detection and workforce awareness of it.

Guardian's integration with CAS 4.6 means properly equipped office personnel, equipment operators and mine site pedestrians can receive near-real-time equipment visualization and timely alerts about hazardous areas and no-go zones.

The no-go zones are defined in Guardian, which creates geofenced zones, hazard maps and alarms. HxGN MineProtect solutions, such as CAS's in-cab display and the wearable Personal Alert, deliver the alarms and other specifications.

Hexagon Mining described the development as an industry first. "Others have point-to-point or radio-based processes, but can't really drive the information to the whole fleet," Marcos Bayuelo, product portfolio manager, MineProtect, Hexagon Mining, said. "We've reduced the time to communication to the minimum and re-

ally ensured that the people that require the information get it as fast as possible."

The upgrades to CAS and Guardian launched in June 2020, and the field testing that followed revealed some of the capabilities offered through integration.

With the integrated solution, the process of alerting a workforce to a slope stability risk can involve only one person. IDS GeoRadar slope monitoring radars detect movement. That goes to Guardian, which alerts the geotech crew. The geotech then reviews and signs off on the alarms and any no-go zone. "That person drills down to understand the alarm, and confirms it and the no-go zone," Bayuelo said.

With only a click, and at the speed of the mine's network, the alarm and no-go zone specs are distributed through CAS and email. "The no-go zone is in near-real-time transmitted," he said.

"So, now, all the vehicles and the vehicle drivers can see be alerted instantly about the incoming hazard," Bayuelo said. "Now they have the capability to visualize where they should not go. And if somebody gets in this zone, then the supervisor or mine manager will see that somebody is in the no-go zone."

Geotechs can set Guardian to monitor certain areas more critically than it does for others. "You have different levels and it is up to the mine as to what hazardous area is transformed into a no-go zone," he said. "Within Guardian, you say, I want to monitor here, here and here, because this is a slope movement hazard. Once that hazard reaches a level of criticality, then the geotechs decide when this becomes a no-go zone because the risk of collapse is so high that nobody should be there."

IBIS Guardian now assimilates data from, among other sources, the CAS server, Francesco Coppi, production manager, interferometric radars, IDS GeoRadar, said. It "can automatically import the position of vehicles and working machin-

eries and visualize them in real time on the radar displacement maps," he said. "Highly accurate displacement data is provided to monitoring specialists in near-real time, as it happens, and using an advanced automatic atmospheric correction algorithm to avoid any mistake."

The primary benefit offered by the integration is speed. "What it does is it allows you to really not require manual communication between supervisors and the control room," Bayuelo said. "It enables you to really create a workflow automatically through the system integration."

Without the integration, you are living in 2019, he said. "Somebody in the control room, or that is monitoring the hazardous area, has to call somebody in the mine that now needs to go somewhere to block the area, which would transform this process into a half hour or more."

Another benefit is awareness of who is in or near the no-go zone. "Which means that nobody has to count," Bayuelo said. "Nobody has to be present, because technology is the one that is present."

The biggest dividend is increased safety, Neville Judd, communications director, Hexagon Mining, said. "It is important because it is linking two ecosystems that were previously unconnected," he said.

"That separation potentially put people at risk and now the two things are connected and we've made that automatic,"

Judd said. "People can now know, if they are using the system, that they can depend on being informed immediately if they are in danger, whereas previously that wasn't the case."

The development should help prompt customers who have one of the two software solutions to upgrade it and to adopt the other, Bayuelo said. Upon adoption, any training required should be minimal and center on workflow changes.

"The new information that will be presented to them will be intuitive enough for them to understand it," Bayuelo said. "There is not a huge change management or training regimen required."

The integration illustrates a couple of the missions of Hexagon Mining and parent company Hexagon AB. "We are now building solutions that can interact with each other, talk to each other, make decisions with each other, and enhance the overall sum of our solutions," Bayuelo said. "We don't only offer the best solu-



GroundProbe's flagship slope monitoring platform, MonitorIQ, offers a one-screen view of all the sensors, to include third-party sensors, in a mine, offering near-real-time visibility of all movements and deformations. (Photo: GroundProbe)

tions, but the solutions themselves make the business outcomes better, which is the end goal of our company."

Platform Uses Most Sensors

GroundProbe reported seeing strong demand for the MonitorIQ platform. The supplier's chief operating officer, David Noon, said because of its unique capabilities, the aggregation software system is destined to become the standard platform for the majority of open-pit mines around the world.

The platform can assimilate data from more than 100 types of sensors, including types made by competitors. "It offers the largest number of sensors you can incorporate into a system," Noon said.

"We have not locked out any data source from this platform," he said. That combined with robust processing analysis creates "a very data-rich environment for customers" to support confident decisions on monitoring requirements.

"It will allow the mine to do some pretty incredible things, including looking more at the data science around what each sensor provides and how it compares with other sensors," he said.

The platform offers a single-dashboard aggregation provides an overview of a slope or tailings dam, the company said.

The development of MonitorIQ goes back to 2004 when a customer reported needing the ability to assimilate data from multiple sources on a single platform. "It was a brilliant idea back then, but challenging to implement," Noon said.

"It probably hasn't been until the last five years that this really has been able to be



Recent updates allow Hexagon's HxGN Collision Avoidance System and IDS GeoRadar's IBIS Guardian to communicate directly for speedy slope stability alerts and the rapid creation of geofenced no-go zones. Above, an IDS GeoRadar unit scans a shadowy distant slope. (Photo: Hexagon Mining)

adopted because of expansion of IT in the mining industry,” he said. Now it can come standard with GroundProbe equipment and eventually “will be installed across the entire GroundProbe fleet for our customers.”

The system has a number of features that all but ensure widespread adoption. It runs safety critical software complete with a programmable alert system, and it offers an intuitive interface that facilitates reporting and supports efficient workflows.

MonitorIQ runs the company’s SSR Viewer software, which provides data analysis capabilities to detect movement and can be programmed to send alerts.

“We have two types of notifications,” Noon said. “There are the alerts built into the GroundProbe monitoring systems through what we call an alarm center.” They give a warning when movement is detected by a GroundProbe system.

“And then in the MonitorIQ platform, with all of the third-party sensors, you can set thresholds or triggers on data and on trend analyses,” thus predicting movement and giving an early warning, he said.

The alarm center uses “a watchdog system to watch the software so if it is not functioning correctly, the user gets an alert,” Noon said.

Designed to be easy and intuitive to use, MonitorIQ offers a one-screen view of all the sensors in a mine. “If you want to see all the movements or deformations measured by all these different types of sensors, whether they are point mea-



Reutech Mining’s MSR Modular series models can be truck-mounted, can integrate other sensors and third-party solutions, and can operate in extreme environments. Above, a unit scans for submillimeter movement at Landau coal mine in Mpumalanga, South Africa. (Photo: Reutech Mining)

surements or line measurements or area measurements from different types of GroundProbe sensors, or even third-party sensors, you get to see that all on a single display and see how they all tell a similar story,” Noon said.

The capability helps streamline report generation to vastly reduce the time involved. “They can design a standard template and then draw in the data sources into the template; and then, when they run the report, it automatically updates the report based on the live data from the MonitorIQ software,” Noon said. “It is meant

to be a workflow process to make it much simpler to get the data to a form that can be easily understood by the operators.”

The platform is designed to be a core system in an integrated mine operation. “It is a platform that the industry has been talking about for a long time,” Noon said. It is more than a product, he said. “It is building in an ongoing support for the life of the mine,” he added.

Recently, the supplier released a solution that was developed with customer input and meant to help miners move toward increased digitization. SSR-Agilis is a turnkey, rapid-deployment, vehicle-mounted standalone monitoring system that uses 3-D real aperture radar. It is ideal for smaller operations that need a highly mobile radar system, Noon said.

“The customer asked to put a radar that is typically on a trailer on a vehicle to be able to move it in close and focus it exactly on a work area, protecting the crew working directly underneath a slope,” Noon said.

SSR-Agilis measures submillimeter deformations, and maintains that accuracy even as range increases. It can sit anywhere from 30 m to 1,400 m from the target.

It is designed to be easy to use, and to provide optimal visualization. “The customer is able to see the wall with a camera image, but also with the radar data overlaid on it or co-registered with it. When they see the heat map of the radar image moving, they can, with their eyes, directly identify the location on the slope that is moving,” Noon said. “GroundProbe is the



GroundProbe’s SSR-Agilis is mounted on a light vehicle for easy relocation, and can sit anywhere from 30 m to 1,400 m from the target. It has an integrated camera, making it easier for users to locate movement detected by radar. (Photo: GroundProbe)

only technology that provides a co-registered visual image and radar deformation image to help to make a very quick intuitive decision when safety is on the line.”

One result is increased decision confidence. “From a user’s perspective, that is the most valuable,” he said.

The customer selects the model of light vehicle, and GroundProbe takes it from there. “We deliver the vehicle of their preference with the equipment installed on it out to the site,” Noon said.

The solution broadens the already vast range of monitoring offerings from GroundProbe. “The technology that sits on this platform is common across all those platforms so all the software, all the support and all the benefits that we have are common across all the platforms.”

SSR-Agilis, of course, can speak to Monitor IQ. And both can be supported by our area reps and remotely.

“We are able to give solutions or solve problems or do repairs or maintenance to make sure the equipment is running with as much uptime as possible,” Noon said. “The miners really appreciate the local and remote support, especially in this time of COVID restrictions.”

Modular Series Does Double Duty

Reutech Mining reported the MSR Modular series, known for versatility, offers simultaneous critical and strategic monitoring capabilities with submillimeter precision, making it the most advanced system of its kind on the planet.

The third-generation movement-and-surveying radar system is designed to operate in extreme conditions, and can integrate with technologies from third parties, such as Licia GeoMos, Trimble 4D, QuickSlope, SlideMinder and Rocscience.

MSR Modular offers multiple mounting options, including trailer mounted, fixed installation or vehicle mounted. The operating temperature range runs from -50°C to 55°C. Units are equipped with an integrated onboard weather station with advanced atmospheric correction algorithms.

Models within the series are licensed for operating at as close as 30 m to as far out as 4,000 m. They can operate off-level by as much as 15°.

MSR Modular is known for its modularity, Reutech Mining said. “It provides building blocks that consist of a radar module, battery module, generator mod-



The Scan2K is designed to fill the gap between smaller short-range scanners and bigger long-range scanners. Unlike other LIDAR scanners, Scan2K can operate in mines that use prisms in slope monitoring. (Photo: Carlson Software)

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ule and solar module,” Jan de Beer, executive manager, Reutech Mining, said. “This allows for custom solutions for each requirement.”

The MSR is also known for reliability and accuracy. “It offers operational availability of more than 99%,” de Beer said. “It can detect submillimeter movement over long distances in harsh environments and volatile atmospherics.”

Units are capable of simultaneous strategic and critical monitoring. “A single standalone system will alarm on movement in critical areas while also doing wide-area or strategic monitoring,” de Beer said.

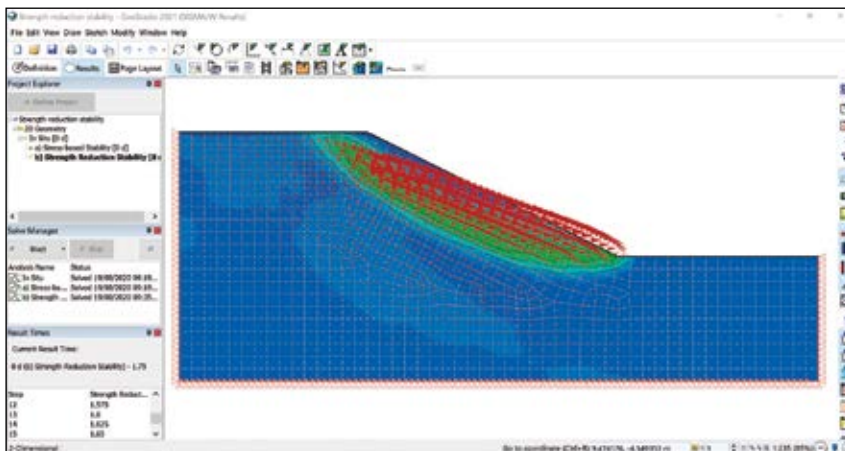
When powered by MSR Connect, the series “is the most cutting-edge geotechnical monitoring solution available on the market,” he said. “It is considered to be the world’s most advanced slope stability radar, improving safety and productivity through accuracy and reliability.”

It can operate as a stand-alone system, or “other products can be integrated with the MSR to enhance your geotechnical monitoring program,” de Beer said.

“The Multi Purpose Platform offers a mounting platform for various sensors and equipment,” he said. “Typical sen-



Equipped with a camera, inclinometers, and a LIGNSS receiver, Scan2K can be wired for power and data, or can operate on a battery and wireless. It can be controlled by third party slope stability software. (Photo: Carlson Software)



Geostudio Core integrates the three most popular GEOSLOPE programs. One is a new version of SIGMA/W, rock deformation modelling software with a comprehensive material model library and automated strength reduction stability analysis. (Image: Seequent)

sors include the Slope Vision camera, in pit alarm systems, personal alarming devices, automatic weather stations and Wi-Fi repeater stations.”

After-sales support includes a 24/7 call center, on-site support, geotechnical support, and advanced virtual remote support.

MSR Modular reflects the company slogan: Safety and productivity through accuracy and reliability, de Beer said.

“We listen to what our client’s needs are and we assist in providing custom solutions to problems,” he said. “Our mission is to understand the mining environment and to provide the industry with world-class products.”

LIDAR Scanner Bridges Gap

Carlson Software showcased the Carlson Scan2K, set to soon be co-released with software. The laser scanner is equipped with an integrated high-resolution camera, inclinometers, a compass, a LIGNSS receiver and weatherproof housing, and is designed to “bridge the gap” between small short-range sensors and large long-range sensors, the company reported.

It is a “high-accuracy, LIDAR scanner that is extremely easy to use and easy to integrate into existing or new slope stability monitoring solutions,” Bradley James Husack, special project engineer, Carlson Software, said. “The amount of training in the use and setup of the Scan2K is very minimal and very intuitive. That combined with the lower cost of ownership and enhanced operational capabilities, the Scan2K is a great choice.”

The supplier adopted the LIDAR technology last year and announced Scan2K

in early 2020. The solution exemplifies how far LIDAR in general has evolved in two decades, Husack said. “The Scan2K can and does provide an effective and economical solution that can help enhance and help with stability monitoring.”

Company literature described the scanner as “perfect for all applications, with programmable data collection rates that enable a range of up to 2,000 m.” It has a range accuracy of 5 mm at 100 m and a range resolution of 2 mm.

Features include “three range settings: 250 m, 750 m and 2,000 m with associated pulse rates of 500 kHz, 200 kHz and 50 kHz, respectively,” Husack said. “For each pulse at those data rates, the scanner will record up to four returns, which is extremely helpful for vegetation and dust penetration and bare earth applications.”

The vertical view can be adjusted from the maximum 120° to a narrow field, he said. “This will allow the system to collect data at the set data rates over a smaller vertical field of view, which will allow denser data point collection.”

The variable range, scan rates, and vertical view allow for customized and detailed scanning of areas of concern.

“The Scan2K will also work with survey prisms that are in the scanner’s field of view that might be mounted or positioned on the target area slope that are being used for other methods of monitoring,” Husack said. “Why this is important is that other LIDAR scanners will shut down if a prism is detected or encountered in the scan as a means to protect the optics of the scanner,” he said. “The Scan2K was designed in such a way that it will be protected and

not shut down when it encounters these prisms at typical monitoring ranges.”

The scanner can be mounted on a tripod, vehicle or moving platform. It can be wired for power and data or can be battery-powered and wireless.

It can be controlled by an onboard touch-screen color interface that remains visible in direct sunlight or, remotely, by a tablet or PC running ATLAScan Software, a data management system for scan projects.

ATLAScan offers target-free automatic alignment, 3D meshing, automatic line features extraction and monitoring. Scan2K can be paired with Point Cloud Software, which offers automation for large data sets. The software can process millions of data points and has the ability to go from field scan to finished plat.

The scanner can also be controlled by third-party slope stability monitoring applications.

Aggressively priced, the Scan2K was set for market release in H1 2020, but was delayed to Q4 due to the lockdowns. The introduction of “the most versatile terrestrial laser scanner on the market” now is a subtle flex by the supplier, Hu-

sack said. “This shows the forward-thinking and evolution of Carlson Software.”

Integrated Software Optimizes Modelling

Seequent released GeoStudio Core, which integrates the three most heavily used programs in the GEOSLOPE suite and offers comprehensive modelling of a wide range of soil and rock behavior.

GeoStudio integrates SLOPE/W for modeling slopes; SEEP/W for modeling groundwater; and a reformulated SIGMA/W, with a comprehensive material model library and automated strength reduction stability analysis, for modeling rock and soil deformations.

The integration allows users to conduct multiple analyses all within a single project file, Seequent said. “Results from one analysis can be used by another, or analyses can be made to simultaneously model stresses and groundwater flow,” said Paul Grunau, president, GEOSLOPE, Seequent.

GeoStudio supports multiple geometries within a single file, making it easy to compare the effect of mine geometry on stability and groundwater flow, he said. “It is also multidimensional, meaning that 1D, 2D,

3D, Plan View and Axisymmetric are all contained within a single project, with results seamlessly shared between 3D groundwater flow analyses and 2D stability analyses.”

Thus, it offers “the most rigorous saturated-unsaturated groundwater flow formulation in the geotechnical software market,” Grunau said. GeoStudio is “the only solution in the world offering the capability of conducting both a General Limit Equilibrium analysis and an automated Strength Reduction stability analysis within the same modelling environment.”

The integration empowers the user to analyze the entire lifecycle of a mine, from conception to closure. It can create a digital twin of a mine for use in detecting and resolving all potential failure mechanisms, Grunau said. “It allows the engineer to make confident decisions regarding mine design,” he said.

GeoStudio Core is a Windows application available by subscription. It can be run as a standalone application. Or, when used with Seequent’s Central, for cloud-based file management, and Leapfrog, for digital twin management and modelling, it can offer a single source of truth in change management.



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New Wireless Network Solutions Mesh With Mining's Data Demands



IWT says its integrated wireless network allows mine operators to choose features to support today's needs and add features as required: voice communications, text, tracking, gas monitoring, operational data, analytics and more.

Access is an important word in the mining industry's lexicon. Mining companies need access to areas of potentially valuable mineralization, to the agencies and government officials that assess and award mining concessions, and to sources of investor funding. On a more technical level, they increasingly need immediate, reliable access to data from IoT nodes and equipment monitoring systems in order to maintain safe, efficient operations. Two recent product announcements highlight the rapid rate of advance in the wireless networking and communications technologies available for both surface and underground applications.

IWT Expands Networking Capabilities

Wireless technology supplier IWT has introduced its latest innovation: the Wireless Working Section, based on the company's new SENTINEL Uniti Node. The Uniti Node, according to IWT,

consolidates all the capabilities mines need for now and in the foreseeable future: a high bandwidth, wireless backhaul for production data; a 2.4-GHz, industry-standard Wi-Fi Access Point; and communications, tracking and sensor support. Power is supplied from either a 110-VAC AC-to-DC power supply or a battery.

The wireless platform, said IWT, is easy to deploy and the mesh connections it offers allow users to find the network and link up automatically, according to the company. No preprogramming is necessary.

IWT said the SENTINEL Uniti Node not only handles underground tracking and communication functions, but also provides the infrastructure to transmit data from production equipment at the face to the surface. "The real benefit of the Wireless Working Section that mines see is increased productivity by improving workflow," said Brad

Hartwick, IWT's Midwest sales director for mining and tunneling. "It offers the tracking, communications and data features that users would expect, and it provides Wi-Fi at the face. Maintenance personnel, for example, can now FaceTime a factory technician and get assistance in diagnosing an issue in real time. SENTINEL Uniti also enables the users to establish data analytics and perform SSI [Short Session Interval] time studies."

Earlier this year, the Mine Safety and Health Administration granted IWT an Intrinsically Safe Approval for the Uniti Node system.

According to IWT, more than 100 mines use its SENTINEL system, and one of its customers, a coal operator in the eastern U.S., saw productivity increase 15% based on efficiency improvements. "The standard IWT communications and tracking system provides voice, text, tracking and data, which is a huge productivity enabler," said Matthew Fisher, program manager for IWT.

SENTINEL Uniti adds high-speed data rate backhaul and offers local Wi-Fi access in conjunction with battery-powered voice, text and tracking system. Any Wi-Fi enabled device can connect to the network, Fisher explained. "And, when there is an emergency, the mine still has the post-incident voice, text and tracking system enabled for a long time as it's very energy efficient. We have some cases where the safety side of this technology has proven to be life-saving."

The system supports the new MSHA and NRTL-approved SENTINEL wireless gas monitor that IWT launched at the beginning of 2020.

The company also has developed a surface mine monitoring solution called Envök. "We have a wireless network that can operate in rugged, remote areas, and can connect to existing sensors and equipment," Fisher said. "Why not apply this technology to regularly monitor run-off, groundwater and tailings?"

Mines often must meet a predetermined set of environmental guidelines regarding runoff. “Envök would collect water quality data and eliminate the need to manually sample the data on a pump or a sensor on a well,” Fisher said. “Manual data entry can be error prone. This system would offer real-time, live connectivity to sensors. Environmental managers and engineers can view this data on their phones and manage it from the office. The system works in remote places with limited or no cellular service.”

Hartwick added, “During the COVID-19 pandemic, companies had to adapt quickly to working remotely. This technology has solved that issue for many customers.”

IWT’s wireless network is simple and easy-to-use, Fisher explained. “With minor configuration in the web application, the end users can see the data and decide how they want to present it to the organization,” Fisher said. “Mine owners would have an automated solution and they could demonstrate to regulators that they are being proactive.”

The system could also be configured to signal ground movement to warn of a potential dam failure or landslide. “The system could monitor extensometers and, when ground movement hits a certain threshold, certain people are alerted immediately,” Fisher said. “This system could monitor conditions and send emails and alerts. It could also trigger other events to happen, such as sounding an alarm, closing a well or powering up a pump.”

The adoption rate for remote monitoring systems varies throughout the mining business. Some organizations know exactly what they want and others just know they have a problem. IWT can provide a turn-key solution for both, Fisher explained. “Different vendors provide sensors with different accuracies and this is an adaptable architecture that connects everything,” Fisher said. “The system can take values from two different sensors and combine that into new data and monitor that as well.”

Envök reduces the manpower associated with monitoring all those items, Hartwick explained. “In a day, a mine engineer in the western U.S. could trav-

el a 300-mile loop to manually record data from every point. Wireless devices can transmit all this data to one device within seconds. It will make the whole process more efficient.”

An Envök turn-key solution can solve a lot of data collection problems, Fisher explained. “We assist in design, installation and maintenance,” Fisher said. “And, we provide an interface that allows users to manipulate values that they understand rather than programming custom apps. We are simplifying the installation process and eliminating the need to write code.”

IWT said it already has installed some Envök systems and anticipates working with additional mines to implement pilot programs.

Wireless Smart Switch for Overland Conveyors

The Schmersal Group, in cooperation with aconno GmbH, has developed prototypes of an Industry 4.0 switch capable of wireless data transmission over distances of several kilometers for use with extended conveyor systems. The integrated wireless transmitter in the HDS series switches transmits status data for each individual switchgear unit via a common wireless mesh network to a cloud system. The prototypes are currently undergoing practical tests.

Schmersal said the new HDS switchgear series was developed specifically

to meet the requirements of bulk materials handling operations. The switchgear unites a range of functions into a single platform, making it suitable for a wide range of applications. Typical application areas include emergency-stop shutdown, belt misalignment monitoring in the transport of bulky materials and level monitoring in material silos.

The emergency-stop and belt misalignment switches in the HDS series now accommodate wireless transmitters made by aconno, allowing diagnostic information to be transmitted from the switches more quickly and with greater efficiency. The switches have been integrated into a mesh network to enable status data to be transmitted from one node to the next over distances of up to 250 m. This, in turn, facilitates communication over several kilometers and, in particular, can simplify switchgear monitoring in large-scale conveyor systems.

All switching operations can be monitored in real time and online via a web browser on a PC or smartphone. The data from the cloud can be transmitted directly to the control center or to maintenance and service technicians’ smartphones on site using the web interface or app. Malfunctions in conveyor systems are recorded in the cloud immediately and actuated switchgear units can be uniquely assigned, allowing for rapid troubleshooting by maintenance personnel. This, said the company, eliminates lengthy searches for faults in conveyor or system command and operating chains, minimizing disruption caused by production outages and improving machine availability.

In addition, said Schmersal, depending on the distance and the environmental conditions of larger conveyor systems, the investment costs for this Bluetooth solution with a wireless mesh network are only a fraction of the system costs of conventional fieldbus systems with decentralized structures.

The German startup aconno develops customer-specific hardware, Bluetooth and sensor solutions, including Bluetooth chips and a development platform for individual Industry 4.0 applications. Schmersal Group owns 26% of aconno GmbH.



The HDS switchgear can consolidate a range of functions into a single platform, such as emergency-stop shutdown, belt misalignment monitoring and level monitoring in storage silos.

Erzberg Builds Truck Trolley System



A trolley system using overhead lines was tested at an iron ore mine in Austria. The system allows for switchbacks. (Photo: Liebherr)

Part of an effort to cut fuel burn and emissions, miner VA Erzberg GmbH and Liebherr tested a trolley-assist system for T 236 diesel-electric haul trucks at the Erzberg iron ore mine near Eisen-erz, Austria. The \$23.5 million project hopes to prove unique purpose-built technologies.

For the tests, a truck was modified to operate with an overhead line connected through a current collector on a 500-m-long uphill-haulage test track. The arrangement, differing from conventional pantograph systems, allows for small radii and switchbacks, and for better usage of the haul road.

When in trolley mode, the full power capacity of the electric wheel motors can go to building speed while the diesel engine idles. This cuts fuel consumption and emissions, two goals of the project.

The miner reported it burns 4.5 million liters per year of diesel to transport more than 13 million metric tons per year (mt/y) of rock. That figure could be reduced by 3 million liters if the new system performs as planned, the mine reported.

“In addition to the positive environmental effects, an investment in this new technology also secures the sustainable extraction of iron ore for domestic

steel production,” said Josef Pappenreiter, technical director, VA Erzberg.

At the end of September, the trolley line was extended to 5 km. The miner will now track how Alpine winter weather affects the overhead lines and the performance of six T 236 trucks.

Freeport Taps Wärtsilä for 128-MW Plant for Grasberg

PT Freeport Indonesia selected Wärtsilä Corp. to provide a 128-megawatt (MW) power plant for its Grasberg mine at the Amamapare port in Papua, Indonesia. The contract covers 14 Wärtsilä 34DF dual-fuel generating sets. Wärtsilä and partner PT PP will install, construct and commission the plant.

The electricity will power the mine, which operates independent of the local grid and requires a 60-Hz power supply. The miner needs the electricity to launch underground operations, PT Freeport Indonesia said.

“For this it is critical that we have a reliable and efficient energy supply, and the Wärtsilä generating sets will deliver the power we need,” PT Freeport Indonesia Executive Vice President George Baninni said.



The fast-starting Wärtsilä 34DF generating sets that will power Grasberg’s underground mining operations can run on biodiesel and natural gas. (Photo: Wärtsilä)

Wärtsilä has power plants in the region, and the supplier's presence in Indonesia helped it win the contract, the company reported. Nonetheless, "the competitive total lifecycle cost of the Wärtsilä solution was ultimately the deciding factor," said Kari Punnonen, energy business director, Australasia, Wärtsilä.

The Wärtsilä 34DF engines can operate on a variety of fuels. Initially, the engines will run on Indonesian B30 biodiesel.

The Wärtsilä equipment is scheduled for delivery between July and November 2021. The first seven engines are expected to be officially handed over in March 2022, with the remaining seven to be handed over in July 2022.

Metso Outotec Wins Order From Zijin

Metso Outotec signed a \$29.4 million contract with Zijin Mining Co. Ltd. for the delivery of processing equipment to the Qulong copper mine project in Tibet. The scope of delivery includes a 58-MW grinding circuit equipped with horizontal and vertical grinding mills,

process automation, and installation and commissioning services.

Metso Outotec said the solutions will help Zijin Mining in their quest to create a sustainable world-class operation with high productivity and cost effectiveness. "The merger of Metso and Outotec has strengthened our local business presence, which will be of great benefit to the implementation of the project," said Stephan Kirsch, president, minerals business, Metso Outotec.

With copper reserves that exceed 10 million metric tons (mt), the Qulong copper mine is a high-altitude operation. The mine's concentrator sits on the Qinghai Tibet Plateau, often referred to as the Roof of the World. After the completion of the project, the ore handling capacity of the concentrator will reach 150,000 mt per day.

Metso Outotec also reported it will deliver two Vertimill VTM-4500 stirred mills to a gold mine in Australia in 2021. The mills will be the largest of their kind installed in that country.

The company reported a two-year extension of the Life-Cycle Services agreement with Boliden's Aitik copper mine



The AG mills for Boliden's Aitik copper mine use Metso Outotec's Megaliner mill lining. (Photo: Metso Outotec)



Metso Outotec was contracted to deliver a 58-MW grinding circuit equipped with horizontal and vertical grinding mills to Zijin Mining's Qulong project in Tibet. (Photo: Metso Outotec)

in Gällivare, Northern Sweden. The agreement covers the supply of mill lining, chute lining solutions, preventive maintenance of the grinding circuit, and recycling of used wear parts.

The contract is a performance-based cost-per-ton agreement, and seeks to maximize availability of the grinding circuit and production. In 2019, the mine produced close to 41,000 metric tons of copper, employing nearly 800 people.

Separately, Metso Outotec reported its new manufacturing site in Šiauliai län, northern Lithuania, started operations. "The new plant further strengthens the company's capability to produce high-quality rubber and poly-met wear parts."

FLSmidth Solution to Automate Terminals in Brazil

FLSmidth received an order for BulkExpert from a customer in Brazil. The solution will fully automate the stockyard operation of two large iron ore shipping export terminals in the south of the country.

The customer has a five-year relationship with the supplier, and satisfaction with that relationship prompted the order, FLSmidth said.

"The order is a clear vote of confidence for FLSmidth's work during the feasibility stage and for our focus on high-performing, productivity-providing digital solutions," FLSmidth CDO Mikko Tepponen said.

BulkExpert is a digital solution that allows for the unmanned, fully automated and optimized movement of both material and material handling equipment in ports and terminals. It uses a 3D laser scanning system, RTK-GPS technologies and state-of-the-art control software, FLSmidth reported.

Separately, FLSmidth reported it acquired KnowledgeScape, which will be included in the ENABLR portfolio and will deliver increased automation and output for customers. The digital optimization solution line can increase total output at a processing plant by up to 10% while reducing power, water and reagent consumption, FLSmidth reported.

FLSmidth reported the acquisition will further solidify its position as a leading supplier of digital optimization.

Sandvik to Provide Fleet to Glencore Oz Mines

In late June, Sandvik won a six-year, \$175 million contract from Glencore Queensland Metals for underground mining equipment and parts. The supplier will provide drills, loaders and trucks, as well as parts, service and digital technology to Glencore's mines in Queensland and New South Wales, Australia.

Subsequently, the miner placed an order for \$33 million. The first unit, a Sandvik DD421 development drill rig, was delivered in September.

Sandvik said negotiations on the contract began in 2018. "We spent nearly a year working closely with the Glencore team to identify exactly what was needed for the long-term success of their as-



Starting last June with a six-year contract for Sandvik equipment, Glencore Queensland Metals is moving away from mixed fleets. (Photo: Sandvik)

sets," said Tim Redmond, global account manager, Sandvik.

Management at Glencore Queensland Metals said the development is part of a plan to move away from mixed fleets. "This innovative partnership with Sandvik will help us improve the way we operate and maintain mobile equipment in our underground mines by providing us with a real reduction in the total cost to operate our primary fleet," Simon Pope, Glencore Queensland Metals general manager, said.

Having a single technology platform will help the miner launch intelligence projects and adopt automation, he said. "We look forward to working with Sandvik to share operational and maintenance insights through new and emerging technologies and unlocking further improvements in safety for our people and the productivity of our mines," he added.

Hatch, LTK Reach Final Stages of Merger

Hatch and LTK are in the final stages of negotiating an integration of the two firms. The merger will create a global service provider for the infrastructure, energy and metals sectors.

LTK's expertise in rail will complement Hatch's capabilities in transportation and logistics. LTK's clients will gain access to an integrated multidisciplinary service with large-scale global experience, Hatch reported. Hatch will double its footprint in the U.S. and provide clients with capabilities across transit vehicles and systems.

The companies will make a formal announcement after the final arrangements.

Hatch employs 9,000 in more than 150 countries. LTK has offices in 23 locations around the world and a staff of more than 450.

Redpath Raisebores Record Pilot Hole

Redpath reported it raisebored an 875.1-m pilot hole in Québec, Canada. A Redboer 90EX raisedrill drilled the "record-breaking" hole, which varied by only 0.03% over the length of the hole and was completed ahead of schedule, the company reported.

The previous record for the Americas was 845 m. That hole was also completed by Redpath, and the record stood for more than a decade, the company reported.

Redpath is raiseboring a 1,009-m pilot hole elsewhere in Canada.

Aquiline Drones Will Make Drone Volt Units

Aquiline Drones announced it signed an exclusive five-year U.S. manufacturing and distribution agreement with Drone Volt, a French manufacturer of professional drones.

Under the terms of the agreement, Aquiline Drones will take over the global production of Drone Volt's Hercules 2 and the Altura Zenith. Aquiline Drones will also be the sole manufacturer of the Pensar smart camera, a multispectral sensor with artificial intelligence and edge computing capabilities.

Aquiline Drones said the move would help the company make Connecticut the "drone capital" of the U.S. It "has

catapulted us to the front of the line with world-class design and unmatched capabilities in the commercial drone space,” Aquiline Drones CEO Barry Alexander said.

Drone Volt said the step turns the largest market in the world into a profit sector. “We have created a strong relationship with the Aquiline Drone’s team, which could lead to additional contracts in the future,” Drone Volt CFO Sylvain Navarro said.

Earlier, the U.S. Department of Justice banned the use of department funds to purchase or operate drones made in certain countries.

GHH Acquires Services Supplier in Potash

GHH reported the acquisition of BAT Bohr- und Anlagentechnik GmbH in Kraysberggemeinde. The move allows GHH to offer comprehensive services, to include repairs and parts, in the German potash and salt mining industry.

GHH reported it is considering making special-purpose machinery at the site. “This will not only expand our range of services, but also continue a traditional location in this mining region, which is so important for Germany,” GHH Group CEO Jan Petzold said.

With 25 employees, BAT will continue as BAT Bergbau Service GmbH.

RPMGlobal Software Helps Test Project

RPMGlobal reported it partnered with The University of Western Australia’s (UWA) Energy & Resources Digital Interoperability Industry 4.0 (ERDi i4.0) Testlab, along with Enterprise Transformation Partners (ETP), to help advance standards-based interoperability for the mining industry.

RPMGlobal will supply its mine planning and scheduling software for the AMIRA P1208 Enabling Interoperability in Natural Resources Project, run by the UWA ERDi i4.0 TestLab in Perth, Western Australia.

ETP welcomed RPMGlobal, which earned a place in the project due to its history of enterprise integration efforts and solutions. “The UWA ERDi i4.0 TestLab is excited to have RPMGlobal on board for the project,” John Kirkman, ETP managing director, said. “It follows on from some great success working with

the RPMGlobal team in integrating their software with other ISA-95 aligned solutions in production at operational mines.”

OCP Will Carry MineKleen System

Midwest Industrial Supply contracted OCP Construction Supplies to offer the MineKleen Underground Mine Dust Control System in Northern Ontario.

The MineKleen System can eradicate up to 95% of dust while reducing

water usage by up to 95%, Midwest Industrial Supply reported.

OCP said the system is field proven. “The MineKleen System has been implemented at five of our underground customers’ sites and the feedback has been very good,” Rick Cousineau, OCP owner, said.

OCP, which also offers Midwest’s roadway and tailing dust control products, will offer Midwest’s MineKleen System effective immediately.

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Varel Mining Changes Name to Terelion

Varel Mining and Industrial has changed its name to Terelion. The development follows the sale of the company's oil and gas division.

The company said the changes will allow it to strengthen R&D and marketing efforts. "Terelion will continue to build on



the proud heritage of the Varel brand," Terelion President David Harrington said.

Getman Gets New Website, Brand

Getman Corp. launched a new brand and website. The latter reflects the company's growth and development as a global supplier of custom underground mobile mining equipment, the company reported. The new brand represents Getman's focus on product solutions that fulfill customer expectations and meet the demands of underground mining.

A brand review showed the company has a reputation for delivering unmatched quality and service, Getman reported. "This brand launch represents our resolve to meet changing customer needs for technology, electrification and product development, all without compromising our quality and aftermarket support," Getman Corp. CEO Erik Van Allen said.

H-E Parts Sponsors Schools in STEM Challenge

H-E Parts International is sponsoring two secondary schools to compete in a science, technology engineering and math (STEM) challenge in Queensland, Australia. For the challenge, students from the region will build and test human-powered vehicles (HPV) to a set of specifications. The supplier recently

supplied each school with an HPV, and will provide continued support throughout the 2020-2021 season. The challenge is in its second year.

ABB Partners Will Advance Industry 4.0

ABB announced it will work with the University of Western Australia's new Industry 4.0 test lab, run by Enterprise Transformation Partners (ETP), to advance Industry 4.0 open process automation standards.

Separately, ABB is working with ETP on an integrated systems project at Gold Fields' Granny Smith mine in Western Australia. The project will enhance ABB Ability to support the latest in reliable messaging and interoperability standards.

The project will connect and coordinate mine operators, workforce, equipment and all mining activities in real-time, from face preparation to crusher. It and the test lab are huge opportunities, ABB reported.

"This demonstrates the significant value that can be delivered to customers through interoperability and automation across both processes and systems," Stuart Cowie, head of industrial automation process industries, ABB Australia, said. "It will give ABB valuable insights into digital transformation and Industry 4.0 concepts for mining."



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H-E Parts supplied two schools with human-powered vehicles for a regional STEM Challenge. (Photo: H-E Parts International)



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3 Takes on Tailings Technology

Tailings have historically been a liability for the mining industry, comprising massive volumes of slurry or sludge-like process waste that has to be safely contained for decades, constantly monitored, and isolated from the surrounding natural environment. The weight of accountability continues to press heavily on the industry, amplified by public outrage over a series of catastrophic tailings dam failures.

The spotlight of concern focused on tailings management has illuminated the need for better planning, engineering and upkeep of tailings storage facilities. It has also highlighted opportunities for producers and industry suppliers to develop and apply new equipment, systems and technologies that can, for instance, reduce the cost and complexity of tailings pumping facilities, handle dewatering of high-volume process-waste flows in large concentrators, and even recoup economic value by recovering metal values from fresh tailings. Here are three recent examples:

Coarse Particle Flotation to Scavenge Copper Tails

Conventional stirred tank flotation cells have been the dominant workhorse for economically concentrating low-grade mineral deposits such as copper-bearing sulphide ores. This technology enabled the expansion of copper supply at an affordable price. Despite the great success of conventional flotation, it is known and reluctantly accepted that this technology is very poor for extracting target minerals outside of a narrow particle size range. Typically 5%-15% of recoverable copper is lost due to this inefficiency.

Eriez Flotation recently developed the HydroFloat, a fluidized bed assisted flotation cell, which has proven effective at floating coarse ore particles up to two to three times the size limit of conventional flotation. This technology was first introduced at a commercial scale for base metal sulphides at Newcrest's Cadia Valley operation in Australia. Newcrest very recently announced its plan to expand the application of this technology. There are now other completed HydroFloat installations and a number of additional installations are in the works.

Cadia uses HydroFloat to scavenge fresh plant tails enriched in coarse ore because conventional stirred tank cells are very poor at floating coarse ore. The HydroFloat is an adjunct to the conventional flowsheet and can operate independently from conventional roughers, although they may share the same cleaner circuit. A side benefit of implementing a coarse particle tail scavenging plant is that the mill circuit's grinding target can be increased without losing recovery. Therefore, the mass throughput can be increased with existing assets.

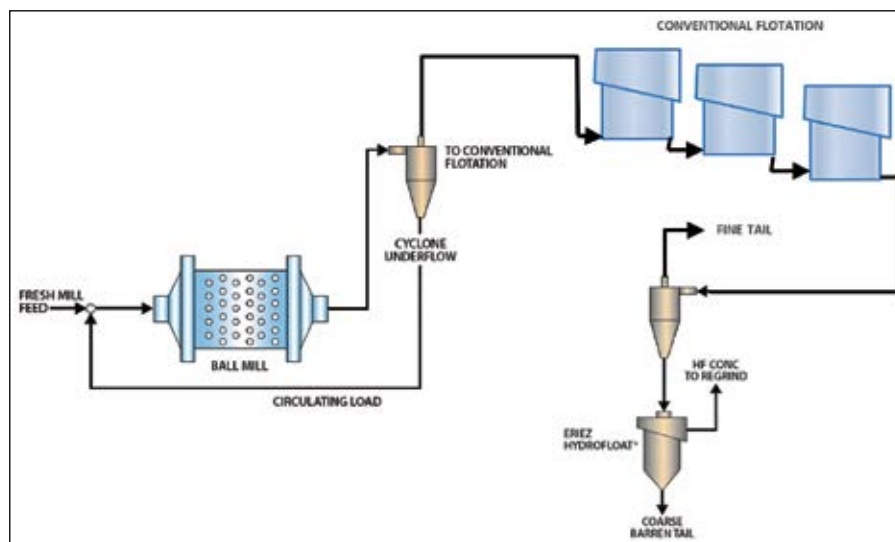
The business case for a tail scavenging application is primarily based on the additional recovery of lost coarse pay-metals, which Eriez reported is typically 3%-5% of total plant production. Based on this potential, Metallurgical Superintendent Umut Erol of Capstone's Pinto Valley operation worked with Eriez Flotation to determine whether the HydroFloat technology would be appropriate for their flowsheet.

Pinto Valley is a porphyry copper mine and concentrator, wholly owned by Capstone Mining and located east of Phoenix, Arizona. As part of their PV3 Optimization Strategy, Pinto Valley is investigating capital improvements to increase overall recovery of copper and to increase mill capacity. The HydroFloat in tail scavenging mode offers the possibility to achieve both.

Since every ore is unique, the metallurgical performance of the HydroFloat is assessed by a continuous 6-in.-diameter lab unit, which can be run at Eriez' full service test lab in Erie, Pennsylvania, or through an approved commercial lab. The scale-up of the results to commercial-scale equipment has been validated on multiple copper porphyry samples.

Preliminary results with Pinto Valley mill tails indicate that more than 50% of the copper and more than 30% of the molybdenum in the final tail should be recoverable with a commercial HydroFloat installation. On the basis of these results, Capstone and Eriez are moving forward quickly to conduct a HydroFloat pilot plant on tails at Pinto Valley later this year to confirm that these results can also be achieved under plant conditions. Lab test work suggests an improvement in global copper recovery of 6%.

Another important result — and a part of the PV3 optimization objectives — is to increase overall mill throughput capacity. This is possible by increasing the target mill grind size since coarse material that does not float in conventional flotation will be picked up downstream in the HydroFloat plant. The results of this pilot campaign could provide the basis for a decision to add a coarse particle flotation circuit at Pinto Valley.



The Cadia mine in Australia — the first to commercially employ Eriez HydroFloat technology — uses it to scavenge fresh plant tails enriched in coarse ore. The HydroFloat is an adjunct to the conventional flowsheet and can operate independently from conventional roughers.



Diemme Filtration's new GHT.5000.F filter press is scheduled for installation at a South American mine site in 2021. The giant filter uses 141, 5- x 5-m plates and will be capable of processing between 140-150 t/h of copper tailings.

In the Works: World's Largest Filter Press

Diemme Filtration, a business unit of Aqseptence Group GmbH, is developing a jumbo-sized version of its GHT-F filter press for high-volume tailings dewatering applications. The new model, known as the GHT.5000.F, has a plate size of 5 x 5 m and total filtration surface of more than 3,000 m². The GHT.5000.F's plate dimensions are twice that of the company's largest GHT-F model. *E&MJ's* editor-in-chief Steve Fiscor recently spoke with Andrea Pezzi, Diemme's sales director for North America and U.K., to get details about what the company claims will be the largest machine of its kind in the market.

E&MJ: How did this machine evolve?

Pezzi: It is an outcome of our industry experience over the course of the last 20 years, as process facilities have increased in size and throughput tonnage. High-volume facilities would require a significant number of filtration lines when using standard machine sizes, adversely affecting the overall attractiveness of the investment. Larger plate size translates into a reduction in the number of filtration lines and improves project economics. For example, we've gone from a standard 2- x 2-m plate size to 2.5 x 2.5 m, and with our GHT.5000.F, we now have a plate size of 5 x 5 m. The GHT.5000.F will have 141 of these plates. It is 37 m long, more than 9.5 m wide and more than 7 m high.

When we begin a major project like this, we work closely with consultants and clients in order to identify the targets that need to be set and achieved. In other words, we want to ensure that what we offer is suitable for the needs of the client's site. Once we identify the basic requirements, we can determine the proper pressure setting, for example. With the GHT.5000.F, we can achieve maximum pressure of 15-16 bar, but it can operate

at lower pressures as well. We also have the choice of plate types to achieve a specific moisture content.

The "F" in GHT.5000.F stands for fast, and the machine is designed to minimize cycle times. If you have what we'd regard as a fast-filtration product, you will be able to achieve cycle times of 12 to 15 minutes, which translates into four or five cycles per hour.

Tons per cycle, of course, is dependent on the product that is being filtered. In the case of copper tailings, for example, we assume tonnage rates of 140-150 metric tons per cycle.

We are designing the GHT.5000.F to be a "smart" filter press that will work within the Industrial Internet of Things, or IIoT. We think that the opportunity to compile data on a constant basis from its operations will result in better maintenance planning decisions and lower operating costs for the customer. We also intend to apply its IIoT capabilities to maximize the process efficiency and optimize power consumption.

E&MJ: What were some of the major design challenges?

Pezzi: With a machine this size, one of the biggest challenges is in terms of logistics. We had to find ways to maintain the robustness of the overall machine design yet optimize the quantity of steel required because the machine may have to be transported and assembled in a remote location.

We had to plan carefully in terms of worker safety when maintaining the machine or changing the filter cloths. We paid close attention to identifying the parts of the machine that need frequent access for inspection or maintenance, and we've provided access points to make the job quicker, which over time provides the customer with lower opex requirements. The GHT.5000.F includes an overhead work platform, complete with safety guards

and handrails, that extends the length of the machine and offers a safe place for workers to carry out their jobs. The filter cloths hang from the top of the plate and have no other point of attachment, making cloth changes quick and easy with the machine's cloth removal tool.

Finally, the machine is designed for fast-fill operations with large feed ports and multiple outlets. Our challenge was to optimize the fill rate without causing excessive wear and abrasion to the valves, piping and filter cloths. We've also included two separate washing systems: a low-pressure wash that occurs at the end of each cycle for removing residual filtrate, and a high pressure wash — at about 50 bar or 725 psi — that takes place at an interval set by the operator to keep the filter media clean and optimize filter cloth service life. We understand water conservation is important, and the system we are providing is designed to reuse wash water, minimizing overall water usage and providing advantages from both economic and social points of view.

E&MJ: What is the next step in development?

Pezzi: We are planning to assemble and test the machine next year before shipping it to a customer's site in South America during summer 2021. This will be accompanied by a virtual launch event that will be available worldwide. We are extremely excited about the project, because it gives us an opportunity to present our company as a solutions provider for an industry that's very important — mining. We want to make people aware that mines are looking beyond conventional approaches for tailings management — some of which haven't worked out so well — and are receptive to new ideas and systems like large-scale filtration and dry stack tailings storage that can reduce their risk. Systems that result in risk reduction are always a good investment.



Weir Minerals Canada built this prefabricated booster pumphouse with features such as an integral gland water supply system, separate eHouse for power controls and remote communications, and three-point pump-base mounting system for easier installation and relocation.

**Reclaiming Tailings Sustainably
With a Mobile Pumphouse**

Water requirements for intensive applications such as hard rock mining and oil sands processing have historically been supplemented by local water sources. Today, these applications face new challenges as the focus shifts to how operations can minimize their environmental footprint but continue to improve productivity while also complying with new regulations.

Weir Minerals suggests the best way forward is not limited to installing energy-efficient products, but also includes working in partnership with companies that can design engineered-to-order solutions.

One of the ongoing challenges for customers is tailings reclamation. The question of how best to reduce dependence on tailings ponds yet expedite reclamation of both water and product in the process was top of mind for one Weir Minerals customer.

Pumping stations are a critical element of tailings management, providing the energy needed to drive the downstream processes. Static slurry pumphouses have until now been the norm, but they are costly and present many limitations when considering alternate tailings processing techniques.

When the customer approached the Weir Minerals Canada dewatering team with a vision to mobilize the pump system for their new tailings treatment process, initially they didn't know if it was even possible.

"The sheer size and energy requirements of the equipment needed for the application meant that this was a huge undertaking from the beginning. You don't normally think of 3,500 horsepower pumps and 160 tons of equipment as mobile," explained Kris Kielar, product manager for Dewatering Engineered to Order Solutions at Weir Minerals Canada.

The Weir Minerals team worked directly with the customer to design an innovative booster pumphouse, engineered especially to manage the Non-Segregating Tailings (NST) on site. The proposed solution was an integral piece to reduce the tailings pond footprint on site through accelerated fines capture and decreased fluid tailings production, thus releasing more water for recycling thereby reducing necessary water intake from local sources. This in turn would expedite reclamation to create landforms that support wetlands and self-sustaining forest ecosystems.

This solution dramatically reduced tailings residence time with a total solution realized through Weir Minerals equipment. Multiflo pump barges mounted with Hazleton submersible slurry pumps extract the target fluid tailings that feed high-powered, land-based, Weir relocatable pump houses. Inside the pump houses, Warman slurry pumps boost recovered tails from the pond to drive the new tailings treatment process plant.

Weir Minerals said its dewatering team designs solutions that also can add value

to a customer's site process. For example, the entire module of the Weir mobile pumphouse can be built offsite at a much lower cost than traditional pumphouses, which are built in-situ. Building a pumphouse in-situ is time-consuming and expensive, as the method requires skilled trades to work for extended periods of time in remote locations.

"Competitor pumphouses built using in-situ construction methods can more than double the construction time and costs compared to the steel fabrication methods we have used," said Peter Pavlin, Weir Minerals' North America general manager of Engineering.

The Weir mobile pumphouse is an innovative solution that provides a variety of pumping possibilities for intensive tailings applications. It's designed to relocate across the site using especially engineered, military-style skid and "jack-and-roll" elements and a novel patent-pending pump/motor suspension system, providing a unique advantage in mobile pumphouse technology. These advances provide operators with distinct advantages over traditional fixed-in-place designs, creating a more agile and cost-effective solution.

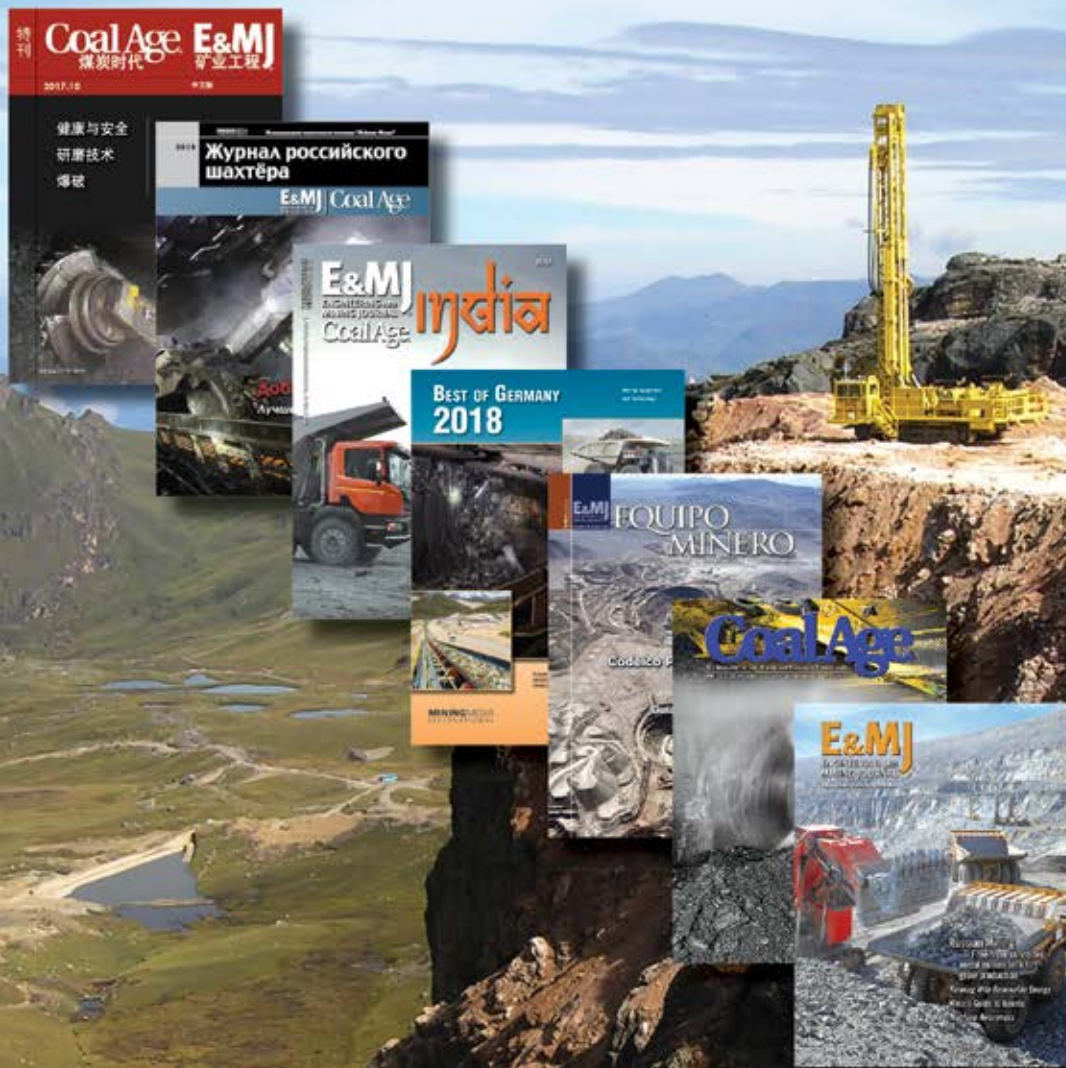
"Our ground-breaking design sets a new standard for tailings management applications. Other pumphouses in the market are static and often cause difficulties for operators when they wish to expand into new areas, as they must discontinue service, resulting in a large capital expenditure. Our solution has overcome these limitations by providing the customer with the tools to rapidly reconfigure a changing pumping network and move it to other sections of the tailings pond," Pavlin said.

The Weir mobile pumphouse incorporates an integral gland water supply system and a separate eHouse for power control and remote communication. A patent-pending, three-point pump base mounting system allows the base and skid to act independently, minimizing the risk of pump and motor shaft misalignment during operation and the relocation process.

"Establishing relationships with our customers is just the beginning," Kielar said. "By working closely together over several years, we learn the ins and outs of their operation. We hear feedback directly from the people who work with our equipment, and that helps us create even better solutions."

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'World First' Battery-powered Scaler



Jama introduced the battery-powered SBU 8000E scaler. The unit's battery solution, co-developed with Epiroc, makes the all-electric machine a first of its kind in the world, Jama reported.

The predecessor mechanical SBU 8000 has been on the market for decades. The new model features a rebuilt driveline, a 160-kilowatt (kW) electric motor, new hydraulic valves, new control system, and modular battery solution. The unit offers the same power as the diesel predecessor model, and it eliminates emissions, reduces noise level, and can help cut ventilation costs, Jama reported.

The battery solution is described as the world's first certified battery system specially developed for mining. It is CE,

UL and CSA-certified. It can be adopted through Epiroc's Batteries-as-a-Service offering where customers subscribe to energy storage capacity and the suppliers manage the system and replace components.

The low-vibration, low-noise, floating cab can be tilted backward up to 13°. The seat is air-suspended, has a three-point belt and double lumbar support, and can be raised and lowered. A large 15.6-in. color touchscreen provides an overview of controls and settings.

www.jama.se

New Cat 785 Offers Fast Data, 1,200 kW

Caterpillar reported the 135-metric-ton (mt) Next Generation Cat 785 mining truck

offers enhanced operator safety and performance, faster and easier access to data, and streamlined maintenance to cut costs.

Truck responsiveness is improved through multiple upgrades, including dynamic stability control, enhanced traction control, machine speed limiting, hill start assist with anti-rollback, and cruise control. Auto Hoist control reduces dumping time, Caterpillar reported.

The payload monitoring system offers more accurate measurement and dipper counts, and enhanced overload detection and carryback calculation and reporting. Guidance information, machine data and electronics controls are consolidated into two touchscreens.

The truck features an integrated speed-coaching feature.

The unit has a 1,193-kW Cat 3512E engine with selectable power options. It is available in multiple emissions configurations, to include an optional Tier 4 Final/Stage V one. It can use 33R51 and 36R51 tires. The larger tires allow a payload of 142 mt.

Production of the truck will begin in Q4 2021. The original 785 was first released in 1985.

www.cat.com

Updated Articulated Trucks for North America

Doosan released the 280-kW DA30-5 and the 373-kW DA45-5 articulated dump trucks to North American markets. The units are based on predecessor models in the line and have numerous updates to improve performance and reliability, the company reported.

Both units feature a hydro-gas self-leveling suspension system. Both have a tandem rear bogie and limited slip differential. The latter transfers power to the left and right front wheels, providing the highest torque to the wheel with the best grip.

Both models have a new brake package for improved reliability, and an updated grease distribution system that lowers grease requirements by as much as 50%.

An active payload measuring system comes standard on both trucks. An LCD screen in the operator cab gives each load's weight. An exterior red-yellow-green light signals to excavator and loader





operators, indicating how close the current load is to the optimal size.

The models also feature a new transmission adjustment lever, allowing operators to choose between set levels of retarder force. The cab offers better ergonomics over predecessor models in the line. Features include a new dashboard and an updated vehicle control unit with a faster processor.

DoosanCONNECT telematics, machine health diagnostics tools, are offered for free. With it, fleet owners and managers can remotely monitor machine location, fuel usage, engine temperatures and work time.

The DA30-5 has a capacity of 16.8 m³, and the DA45-5 has a capacity of 24.4 m³. Both have a maximum speed of 55 km/hour.

na.doosanequipment.com

Seal Guards for Warman Pumps

Weir Minerals announced new telescopic gland seal guards that protect maintenance personnel performing gland seal adjustments on Warman slurry pumps.

The guards never need to be removed to adjust the gland seal followers. The

telescopic design, which can be retrofitted into existing Warman pumps without disassembly, ensures a secure fit no matter how the pump is set up, Weir reported.

The guards comply with ISO 14120, ISO 13857, AS4024.1601 and AS4024.1801 standards, and are available for the MCR, WBH and AH pumps. Additional designs will be engineered upon request.

Manufactured from stainless steel, the guards are painted golden yellow. Warman telescopic gland seal guards are available worldwide.

www.global.weir

Extreme-duty Buckets Endure Excessive Wear

Werk Brau introduced extreme-duty excavator buckets with an aggressive dig angle, rugged construction and horizontal wear strips wear protection. Tapered side plates are engineered to reduce wear and allow for easier dumping.

The bucket is equipped with industry-standard teeth. Tooth size can be increased.

The cutter bit is made from extreme-duty T-1 material and all critical or high-wear components use AR400 through AR500 steel.



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More Possibilities. The Scaffolding System.

By starting with robust, dependable materials, the bucket is designed for heavy-duty action and able to endure excessive wear and tear, the company reported.

Standard sizes are available from 3/8 yd³ to 10 yd³ in various widths with custom designs offered.

Separately, Werk-Brau reported the High-Performance Loader Buckets are designed for strength and durability, and can handle material up to 1,200 kg/m³ in density. The 3° inclined bottom reduces loading forces. The bucket top channel is designed to withstand high digging forces, Werk-Brau reported.

High-strength abrasion-resistant steel is used in all critical components. All seams are welded solid, the company reported.

A curved sidewall allows for greater capacity and higher yield. Auxiliary edge and teeth are available upon request.

The buckets are available in various widths and capacities, up to 7 m³. Special designs are available upon request.

www.werk-brau.com

HPGR Offers Max Productivity

Metso Outotec launched the HRCe high-pressure grinding roll (HPGR). The HRCe offers decreased installation CAPEX over predecessor competition. It provides maximum productivity through superior grinding efficiency, the supplier reported.

The original HRC launched in 2014 and featured flanges and a non-skewing design. Customer input drove development of the new model, Metso Outotec reported. Compared to predecessor competi-

tion, the HRCe offers an energy efficiency increase of 15%, a 24% lower circuiting load, increased throughput of up to 19%, and reduced edge effect and downtime.

Separately, Metso Outotec released the next-generation Courier 6G SL on-stream analyzer for direct measurement of gold, platinum and other metals from ore feed, concentrate and tailings. It has been adopted by Agnico Eagle's Kittilä mine, and offers accurate real-time elemental analysis measurement, the supplier reported.

Compared to predecessor competition, the Courier 6G SL has a more powerful X-ray tube and optimized measurement channels. It combines Wavelength Dispersive X-ray Fluorescence and Energy Dispersive X-ray Fluorescence technologies with a high-power X-ray tube for unparalleled measurement performance, Metso Outotec reported. It features an automatic internal reference measurement for guaranteed stability under changing environmental conditions.

The analyzer can measure up to 24 individual process streams. It is described as ideal for applications where gold is recovered with other metals.

www.mogroup.com

Modeling Software Simplifies Routine Tasks

Carlson Software recently released Carlson Mining 2021, with new commands and controls for the included modules: Underground Mining, Surface Mining and Geology. It runs on AutoCAD 2017-2021 and includes IntelliCAD 10.0.

Carlson Geology includes a new Composite Strata by Interval command for compositing a drillhole by depth interval; and a Composite Strata by Elevation command for compositing a drillhole by elevation range.

Compositing commands are connected with the new Block Model Autorun command, which allows users to save modeling settings and recreate block models as data is modified. Multiple block models can be viewed and compared in the same 3D viewer window.

The new Wash Commands calculate attribute values at different relative wash densities. The Define Wash command imports and builds the wash curves for the desired attributes. Apply Wash is used to load in wash files, apply targets with calculations, and includes the ability to generate output files that may be modeled for the selected relative density.

Carlson Geology also includes new drillhole features like an added status flag, a new Compare Drillholes to Block Model command, and added options to the Custom Drillhole Report.

A new Surface and Underground Mining command, Solid from Survey Points, makes a solid from survey points and a perimeter polyline.

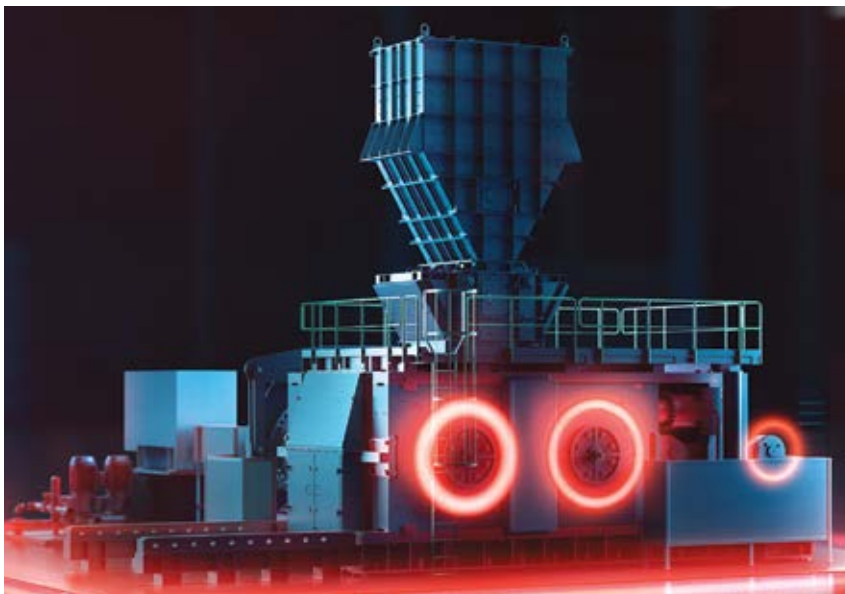
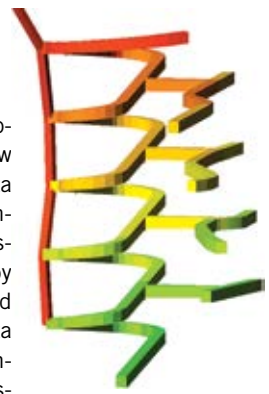
Other new Surface and Underground Mining features and commands include the Tunnel Network Command to create a 3D solid of an intersecting network of tunnel alignments and templates. Underground Solid Timing links 3D Polylines to mining solids, and then schedules them out. Merge Small Benches can run on all the benches or a specific bench. Panel Precedence by Polylines assigns precedence from polylines.

www.carlsonsw.com

Compact Breaker Packs More Power

Brokk released the Brokk 200 for ultra-deep mining applications. With Smart-Concept, the machine provides industry-leading power and productivity with zero emissions, the company reported.

The compact, remote-controlled unit offers power comparable to machines three times its size, but can be run by a smaller crew.





Using SmartConcept, it senses poor power supply and compensates, requires 70% fewer cables than predecessor competition, and can be managed remotely using intuitive controls, the company reported. The unit can carry heavy tools, such as breakers, rock drills, buckets and shotcrete attachments.

www.brokk.com

2.4K GPM Pump Can Drain the Swamp

Tsurumi released the GPN 837 heavy sand pump, the top model in the series, with a water output of almost 2,400 gallons per minute (gpm). The pump is designed for use whenever considerable amounts of solid matter are involved, Tsurumi said.

The unit can pass 30-mm hard rocks. The agitator at the suction opening mixes mud and water so that it becomes more fluid, the company reported.

The pump runs on a 37-kW electric motor and features an oil filter that uses centrifugal force to lubricate in any position. It pumps vertically up to 24 meters. Submerged it is pressure-resistant down to 30 meters. The impeller, suction plate and housing are made of cast iron.

Tsurumi.eu



Medium-duty Conveyor Belt Clamps

ASGCO unveiled the BC3 Safe Grip Conveyor Belt Clamps. The 2.7-mt model is for conveyor belts up to 72 in. wide and up to 0.625 in. thick.

Safe Grip Belt Clamps are made of lightweight high-grade steel and aluminum components and offer lasting gripping force, ASGCO reported. The shock-absorbing end caps are designed to protect the bars from hammer use and drops.

The BC3 clamps are designed for use in light- to medium-duty applications.

www.asgco.com

Remote Lube Health Diagnostics

Des-Case Corp. launched We Monitor, a remote diagnostic-monitoring subscription plan for lubricated assets.

For a monthly price, billed quarterly, Des-Case experts remotely use edge gateway devices, sensors, software, and desiccant breathers to track and consult on lubricant health, cleanliness and humidity inside critical assets.

The service is supported by the IsoLogic platform and app, which provides asset and lubrication status information. The platform can identify trends, provide email alerts and generate reports.

Descase.com

Design Tool Shows Planning Consequences

Deswik with partners Alicanto Labs and Universidad Adolfo Ibañez in Chile released Deswik.GO, a comprehensive strategic design and scheduling tool for open-pit mines.

The software system allows mine planners to optimize the mine shape, phases and sequence. Fast evaluation time allows planners to evaluate multiple options and see the effects of planning decisions, Deswik reported. With it, planners can see the cascade of consequences from a planning decision, or variations to existing plans.

Deswik.GO is interoperable with Deswik.CAD and other modules in the Deswik range.

www.deswik.com

Rugged, Military-grade Handheld

RugGear introduced the RG530 rugged smartphone for professional push-to-talk use in mission-critical areas. It can be used for voice communications, including via low-latency connectivity. The device supports one-to-one and group calls, broadcast calls, emergency alerts, caller identification and direct device-to-device communications.

The Android device is military standard 810H certified. It can be programmed for company-wide full configuration and control.

Features include a replaceable battery, a fast SOS function, high audio quality, water- and drop-proof housing, and disinfection-capable surfaces, RugGear reported.

ruggear.com



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China Coal & Mining Expo 2021.....	11	Mining Media Int'l - Social Media.....	51
<i>E&MJ</i> Website.....	53	Redpath Canada Limited.....	52
Gaudfrin SA.....	9	Sika Services AG.....	61
Haulage & Loading 2021.....	13	Terelion LLC.....	7
Hilliard Corp.....	43	US Coal Show 2021 (Longwall USA).....	39
IDS GeoRadar s.r.l.	37	Valley Forge & Bolt Mfg Co.....	36
Jenmar Corp.....	IBC	Weir Minerals Australia Ltd.....	IFC
Komatsu Mining Corp USA.....	BC	Wilhelm Layher GmbH & Co KG.....	59
Liebherr Holding GmbH.....	3	World Mining Equipment (WME).....	63
Midwest Industrial Supply Inc.....	33		

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ILZSG Issues Forecast for Zinc

The International Lead and Zinc Study Group (ILZSG) held its 65th session virtually during mid-October. The session included a joint meeting of the group's Statistical and Forecasting Committee/Mine and Smelter Committee/Industry Advisory Panel to review the current levels of world supply and demand for lead and zinc and share its outlook for 2021.

World demand for refined zinc metal is forecast to fall by 5.3% to 12.98 million metric tons (mt) in 2020 and to rise by 4.2% to 13.52 million mt in 2021. In China, despite a significant fall in automobile production, refined zinc usage is expected to remain stable in 2020, mainly because output of galvanized plate during the first seven months of 2020 was at a similar level to that same period of 2019. In 2021, Chinese usage is forecast to rise by 2%.

Demand in Europe fell by 4.6% in 2019, after nearly a decade of relative stability. In 2020, demand is forecast to fall by a further 7.7%, however, zinc usage in Europe is expected to recover by 6.5% in 2021.

Elsewhere, demand is anticipated to fall in several countries, including Australia, India, Japan, the Republic of Korea, Taiwan (China) and the United

States. This widespread global reduction in zinc usage is, however, expected to be followed in 2021 by a recovery in most of the countries previously mentioned.

World zinc mine production is forecast to fall by 4.4% to 12.33 million mt in 2020 and to increase by 6.6% to 13.14 million mt in 2021. In 2020, zinc mining activity has been negatively impacted by national restrictive measures aimed at containing the spread of the COVID-19 pandemic.

Canadian zinc production was influenced by the closure of the Langlois mine in December 2019 and the suspension of activities at the Silvertip and Caribou mines in the first quarter of 2020. Production was suspended at the Skorpion mine in Namibia during the first quarter of 2020 and, in the United States, activities at Teck's Pend Oreille operation were halted in July 2019.

Output is also forecast to decline in China, Finland, Kazakhstan, Sweden and Turkey. However, in Australia, South Africa and India, where expansions at some of the Hindustan Zinc's mines were recently completed, a rise in production is anticipated.

In 2021, zinc mine supply is predicted to rise in nearly all of the coun-

tries previously mentioned, but to fall in Namibia and Poland, where the Olkusz-Pomorzany mine is due to close in December 2020.

Global refined zinc metal production is forecast to increase by 0.9% to 13.6 million mt in 2020. This will primarily be a result of an anticipated 1.6% growth in Chinese output and further rises in Australia, Canada, France, Italy, India and the United States, where American Zinc Recycling's secondary plant in Mooresboro, North Carolina, reopened in March. However, output is expected to fall in Japan, Peru and Namibia, due to the suspension of activities at Vedanta's Skorpion refinery in April 2020.

In 2021, a predicted increase in world output of 2.9% to 13.99 million mt will mainly be a consequence of further rises in China, India and the United States, combined with higher output in Japan, Mexico and Peru.

Regarding the global market balance, the ILZSG anticipates that global supply for refined zinc metal will exceed demand significantly in 2020 with the extent of the surplus forecast at 620,000 mt. In 2021, supply is expected to continue to exceed demand resulting in a surplus of 463,000 mt.

E&MJ PRICES INDEX

(October 30, 2020)

Precious Metals (\$/oz)		Base Metals (\$/mt)		Minor Metals (\$/mt)		Exchange Rates (U.S.\$ Equivalent)	
Gold	\$1,878.60	Aluminum	\$1,820.50	Molybdenum	\$17,250	Euro (€)	1.165
Silver	\$23.64	Copper	\$6,694.50	Cobalt	\$32,500	U.K. (£)	1.293
Platinum	\$858.00	Lead	\$1,790.00			Canada (\$)	0.750
Palladium	\$2,240.00	Nickel	\$15,256.00	Iron Ore (\$/dmt)		Australia (\$)	0.702
Rhodium	\$13,400.00	Tin	\$17,650.00	Fe CFR China	\$120.19	South Africa (Rand)	0.062
Ruthenium	\$270.00	Zinc	\$2,524.50			China (¥)	0.149

Gold and silver prices provided by KITCO Bullion dealers (www.kitco.com). Platinum group metals prices provided by Johnson Matthey (www.platinum.matthey.com). Non-ferrous base and minor metal prices provided by London Metal Exchange (www.lme.co.uk). Iron ore prices provided by Platts Iron Ore Index. Currency exchange rates were provided by www.xe.com.



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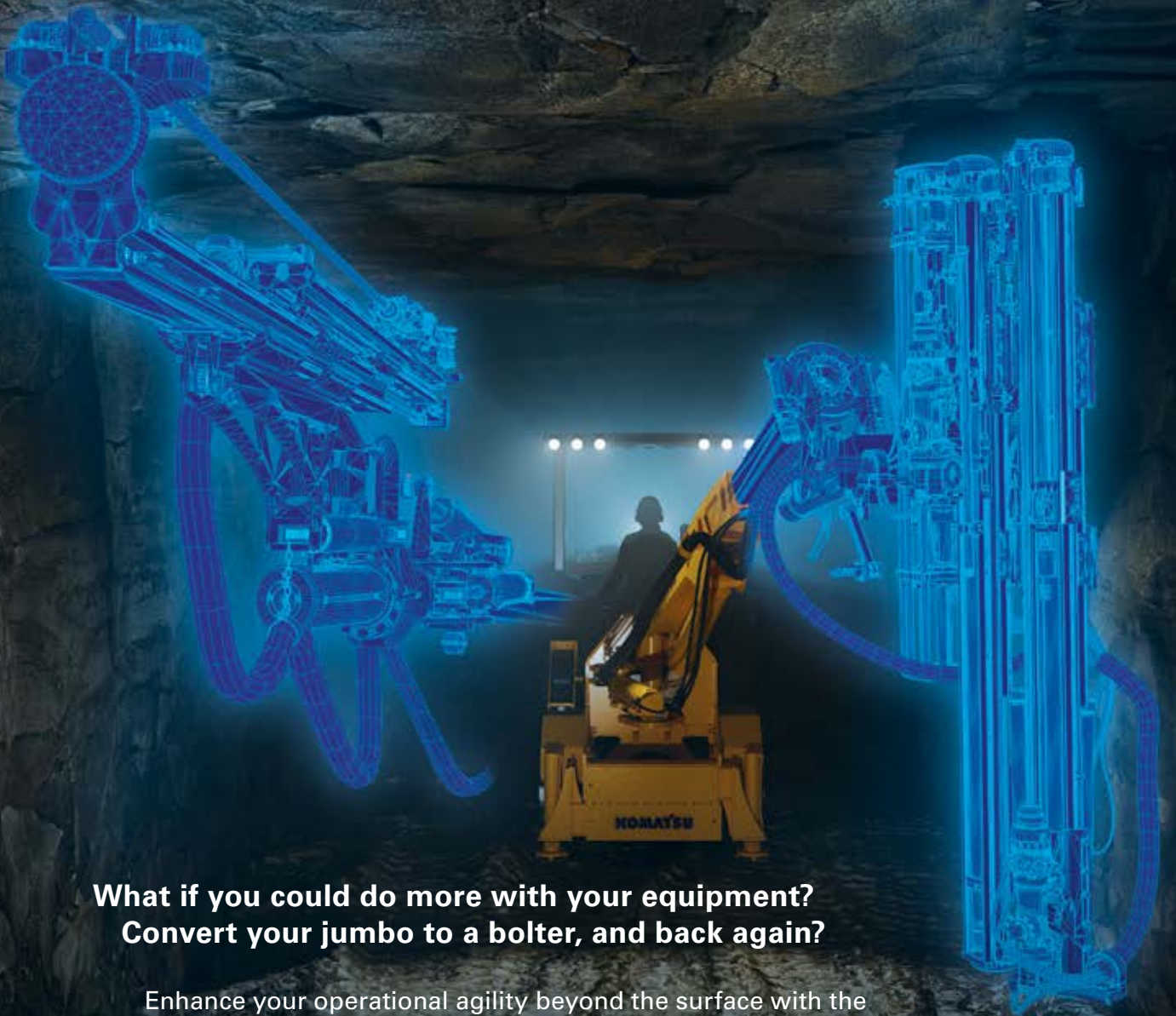
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