

SOLID

#2 2019

GROUND

A MAGAZINE FROM
SANDVIK MINING AND ROCK TECHNOLOGY

Ireland:

**Automation
transformation**

Sustainability:

**Goals for
2030**

Intelligence:

**Electric
future**

Our journey has begun

**A sustainable path
to productivity**

Dear reader,

A sustainable path to productivity

Sandvik Mining and Rock Technology has set its plan in place to become a more sustainable company. By doing so, we will help our customers to become more sustainable and productive too.

How?

For example:

- Our energy-efficient equipment, which produces fewer emissions per pound of output.
- Our products and solutions, designed to make you more productive so that you use less fuel and electricity for the same amount of output.
- Our automated equipment, built for productivity, reliability and durability – delivering more for the same amount of energy input.
- Our digital solutions, with data analysis supporting the optimal usage and performance of equipment – and thereby using less fuel.
- Electrification, reducing the need to ventilate, saving both energy and money – with, of course, a focus on our No. 1 priority, a safer, healthier working environment.

As an organization, we are 100 percent committed to achieving our sustainable business goals: we are doing a lot already, but we can always do more. That is why we are continuing to strengthen our sustainability offering by acquiring specialist expertise such as

Artisan Vehicle Systems (leading manufacturer of battery-electric underground vehicles) and Newtrax Technologies (global leader in wireless IoT and the preferred source of big data for AI for underground hard rock mines).

Sustainability and productivity go hand in hand. We want to help you derive the benefits too, so that together we can play our part in changing our industry for the better. ■



HENRIK AGER
PRESIDENT, SANDVIK MINING
AND ROCK TECHNOLOGY

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Learning anywhere, anytime

▶ In an effort to provide even more avenues to train customers, Sandvik Mining and Rock Technology has introduced an operator training simulator. The mobile and flexible solution enables safer training of operators and maintenance teams on Sandvik DD422i, Sandvik DD422iE and Sandvik DT922i drill rigs. The low-weight training tool is highly portable, enabling it to be used where it is most needed – on site. The simulator has been designed specifically to improve both operator and drilling performance, delivering real benefits for underground drilling applications.

Delivering “real life” training to operators and maintenance teams in a simulated environment, the simulator offers authentic controls combined with the same software installed on the actual drill rigs.

AutoMine interoperability

▶ In an announcement at #DisruptMining 2019, an event focused on fostering new technology in the mining industry, Sandvik Mining and Rock Technology announced it would develop an interoperable platform for AutoMine, its world-leading mine automation system.

“As a world leader in underground automation, we have a responsibility to make this game-changing technology easier to implement for the mining industry,” says Patrick Murphy, president Rock Drills & Technologies, Sandvik Mining and Rock Technology. “Customers with mixed fleets will have the full power of AutoMine behind them.”

To enable interoperability, Sandvik Mining and Rock Technology will introduce the AutoMine Access Application Programming Interface (API), which is a set of functions and procedures that allow the creation of applications that access the features of an operating system, application or other service.

A bigger, smarter, stronger rotary drill

▶ Designed to improve efficiency and deliver dependable penetration in the world’s harshest mining conditions, Sandvik DR416i will help customers enhance safety, improve productivity and reduce costs. The new rotary blasthole drill delivers a single-pass capacity of 69 feet, the longest single-pass mast in its class. Constructed for large-diameter (16-inch) rotary drilling, Sandvik DR416i is automation-ready, scalable and supplies the highest rotational torques and pull-down forces at the lowest possible operating cost. It’s also equipped with Sandvik’s patented Compressor Management System (CMS), designed to reduce fuel consumption and improve productivity.



“In developing the latest addition to our iSeries family, we looked at our customers’ greatest challenges and developed a cost-effective, highly efficient solution,” says Dave Shellhammer, president, Rotary Drilling division, Sandvik Mining and Rock Technology.



Automating El Teniente

▶ Continuing Chilean state-owned miner Codelco’s vision of creating the most advanced underground mines in the world, Sandvik Mining and Rock Technology will deliver AutoMine Fleet solutions for underground trucks to the company’s El Teniente mine.

This AutoMine Fleet system is the first step in implementing a fully automated mining solution using Sandvik trucks at El Teniente, the biggest underground copper mine in the world. Codelco’s goal is to dramatically improve the productivity,

safety and efficiency of its operations with AutoMine. Together with the existing OptiMine system, the mine will become a world-class benchmark.

“As a state-owned mining company, it is our responsibility to implement technology and solutions that ensure the safety of our people and the sustainability of our mines,” says Rafael Guzman, chief engineer for automation and technology at El Teniente. “Being a good corporate citizen is not negotiable. It is critical to our success.”



Commanding intelligence

▶ The versatile new Commando DC300Ri surface top hammer drill rig is ideal for drill and blast contractors as it suits multiple different construction applications.

The new Commando DC300Ri is a radio remote-controlled, rubber-tired surface top hammer drill rig with a vast hole size range (from 1.5 to 2.5 inches) using R28, R32 and T35 MF-rods. It features four powerful tramming motors with maximum tramming force of 43 kN. A reinforced

boom structure with extended swing and reach results in a 20 percent larger coverage area compared with earlier models. A flushing air capacity of 106 cubic feet per minute allows deeper hole depth with larger hole sizes, and the 24-volt electrical system adds durability. In addition, the new Commando DC300Ri can be further equipped with several intelligent options to suit specific needs, including auto-aligning, SanRemo remote monitoring and Remote Screen.



Ushering in the Fourth Industrial Revolution

▶ The award-winning OptiMine Analytics with IBM Watson IoT for predictive maintenance and optimization analyzes, learns and communicates with equipment operating thousands of feet underground. Around the world, clients from Hindustan Zinc in India to Petra Diamonds in South Africa are tapping the powers of IoT, advanced analytics and artificial intelligence to realize safety, maintenance, productivity and operational efficiency.

Through a series of IBM Design Thinking workshops, IBM and Sandvik work with clients to develop a frame-

work to shape offerings around data-driven productivity and predictive maintenance. Using the Watson IoT technology, Sandvik and IBM have jointly created a platform able to comply with the stringent reliability and security requirements of mining operations.

“Our award-winning OptiMine Analytics with IBM Watson IoT solutions offer our customers a more complete view of their operations for smarter, safer and more productive work,” says Patrick Murphy, president, Rock Drills & Technologies, Sandvik Mining and Rock Technology.

THE QUOTE

“Using our mines to full effect is part of our focus on sustainability and a key driver for our business. Automation and optimization are critical to getting the most from our mines and keeping our people safe while we do it.”

Andrés Avendaño, operations manager, Codelco Chuquicamata underground mine



Connectivity from the cloud

▶ Sandvik Mining and Rock Technology has introduced connectivity between SanRemo, the remote monitoring system for Sandvik surface drilling equipment, and Infrakit Cloud, a solution for connecting work machinery, field equipment and personnel on a single platform. The software solution will provide more efficient construction, real-time accessibility of project data and cost savings.

The new solution creates a flow of communication between Sandvik drilling equipment, the SanRemo information management system and Infrakit Cloud. This way the process data generated by onboard automation and TIM3D drill navigation systems can be easily shared with contractors' and civil engineering companies' other systems. A major benefit is the ability to share project data with all the relevant systems and parties: design engineers, drill planners, drill operators, production managers and clients' supervisors, to name a few.



Henrik Ager's longtime experience in mining makes him uniquely qualified to lead the charge to halve operational CO₂ impact.



SUSTAINABLE LEADERSHIP

Since taking over as president of Sandvik Mining and Rock Technology in April 2019, Henrik Ager has guided his charge while staking his position on how he wants his strategic vision of more sustainable operations realized. As a veteran of the mining industry, he shares his plans with *Solid Ground* for how he will shepherd in a more sustainable future for his business area.

Is it possible to achieve sustainable business practices, long-term growth and strong business strategy simultaneously?

Definitely. We've divided our sustainability initiatives into four essential areas, all of which are tagged to our business goals: reducing CO₂ or greenhouse gases (GHG) is one, and a very important one so let me get back to that; circularity, which obviously impacts CO₂ emissions because the more material that we can reuse, the less we need to create; safety, or zero harm to people, which has always been a top priority for us; and compliance. When it comes to zero harm to people and compliance, we currently have mature practices. With circularity and reducing GHG, while we are doing a lot, we have not formalized as much as we could, and we can always do more. Right now, the mining and quarrying industry accounts for 3-4 percent of global energy consumption. So, the more energy

efficient our equipment is the fewer emissions per pound of output they will produce, which helps limit that energy consumption. What we sell and help our customers to use are products and solutions that make them more productive; this allows them to then use less fuel and electricity for the same amount of output. That's the biggest impact we can have on GHG: helping our customers be more productive.

So, you're saying being more sustainable equals being more productive?

Absolutely. And that's both with our customers and in our internal operations. For our operations, we can become more GHG efficient which means more energy efficient. We can also be more GHG efficient by using sustainable energy sources, too.

How important is sustainability for long-term success?

Sustainability is critical to our long-term performance with our customers and as an employer. For our customers, an aggressive approach is essential. Driving productivity and GHG efficiency together is going to be key for us, because if we can't make our customers more productive, we won't survive. As an employer, we have to show that we approach this very seriously and that we have a plan to become a more sustainable company, helping our customers become more sustainable too, so that the whole ecosystem is improved.

What solutions has the Rock Tools division created to reduce its own waste and emissions?

For Rock Tools, one of the most influential ways we can make our rock tools processes more efficient is through logistics. If you ship a drill bit on a boat, it will generate around 100 times less CO₂ than if you fly it to the customer on an airplane. That approach reduces our generated CO₂ by 10,000 tons, which in comparison with the total emissions for the division is significant. Another key focus for Rock Tools is to minimize scrap rates. We also have projects ongoing where we focus on heat generation and heat recovery, where we recover the heat used in production and redistribute it to heat our buildings during winter. And we will obviously look at using greener energy sources.

How can Sandvik Mining and Rock Technology set aggressive goals without sacrificing credibility?

My view is, across all four focus areas of compliance, zero harm to people, reducing GHG and circularity, the more we link our targets to normal business targets and find ways to combine them to achieve a common good, the better chance we have to stick with them. It's when there are targets for sustainability that are not anchored to the business that the risk of them falling to the wayside grows during tough times.

How will Sandvik Mining and Rock Technology adapt its offerings to create a more sustainable model?

There are plenty of examples, I think. We work and are focusing a lot on circularity and GHG efficiency. As I mentioned before, we are constantly developing products and solutions



Ager believes that sustainability goes hand in hand with productivity.

OSKAR OMNE

to help our customers be more productive. We've done so for 150 years and will continue to do so, but one of the really exciting avenues where we're leading is automation. Automated equipment tends to be more productive; it breaks less, lasts longer and delivers more for the same amount of energy input. So, you get the same output with the less GHG emissions.

In the digital space, where we can capture more and more information, analyze it and use it to help operations improve, we've just started to scratch the surface. We will continue to use data and analytics to find better ways to make and help our customers use equipment more productively while lasting longer and using less fuel when it operates. Then there's electrification, which presents an opportunity to take diesel out of mines, particularly the underground mining environment. We know the negative health risks associated with diesel particulate matter, so if we can put electric vehicles in underground operations, we reduce the need to ventilate, saving energy and money.

You will personally spearhead the initiative on halving the business area's CO₂ impact. What will this entail?

If we start with the basics, our own operations will ensure that we have improvement plans to drive down GHG emissions. We'll put this in as an essential criterion when developing new products and solutions to have GHG efficiency and recyclability as essential R&D aspects.

We'll definitely put this in as one of the defining criteria for selecting new suppliers. Where we have the biggest opportunities, however, is with our customers. I want Sandvik Mining and Rock Technology to quantify the GHG impact our products have and the savings they can realize with our solutions.

We can also play a more active role in the industry. We currently sit on the CEO advisory board with the International Council of Mines and Minerals and we must leverage that position to help drive this theme forward together, using our role as a leader to help change the industry, and the world, for the better.

Can you speak to Sandvik Mining and Rock Technology's approach to the UN Global Goals initiative?

The UN 2030 goals make a lot of sense for us. We have to remember that the goals for 2030 are just steps on the way of the future for climate change. We must take ownership, take responsibility and act with strength to ensure that all steps are taken in the right direction. We set our goals for 2030 and 11 years can look like a lot but in many ways it's just around the corner. Our ambition is set high and we aim to make a shift in the industry. We have selected seven of the UN goals but the important thing is to set the overall sustainability ambition high with the complete picture of sustainability in mind. ■



Modern society’s demand for metals and minerals will continue, as will its insistence that they are sourced sustainably. International mining company Anglo American is ahead of the curve with its approach to sustainable operations. The company shares its method for setting and achieving its far-reaching goals with *Solid Ground*.

Can you discuss the “pillars” upon which your sustainability goals are based?

First, it is worth reflecting on our definition of sustainability, and the context for our pillars. A sustainable business is purposeful, competitive, resilient and agile – it’s a business that thrives through both economic and social cycles. By understanding the context and listening to stakeholders we stay ahead of evolving trends and provide the solutions to societal expectations. By solving the physical challenges of mining through restless innovation, and by constantly searching for more responsible ways to do business, we are changing the way our employees and stakeholders experience our business – creating enduring value for all stakeholders. Our Sustainable Mining Plan is designed specifically to drive business efficiencies, resilience and agility.

Our far-reaching Sustainable Mining Plan, launched in 2018 as part of FutureSmart Mining™, commits us to a series of ambitious medium- and longer-term goals. These relate to three major areas of sustainability aligned to the UN’s Sustainable Development Goals.

At the center of our Sustainable Mining Plan

are our three Global Sustainability Pillars:

- 1. Trusted Corporate Leader** – Developing trust as a corporate leader, providing ethical value chains and improved accountability to the communities we work with.
- 2. Thriving Communities** – Building thriving communities with better health, education and levels of employment.
- 3. Healthy Environment** – Maintaining a healthy environment by creating waterless, carbon-neutral mines and delivering positive biodiversity outcomes.

Which key areas of sustainability have you identified for your company and stakeholders to address within those pillars?

Each of the three Global Sustainability Pillars comprises three goals respectively. They are deliberately ambitious and designed to challenge us to lead and innovate, linking into the three elements of our plan.

- 1.** For us, developing trust as a corporate leader means providing ethical value chains and improved accountability to our stakeholders. (See table 1.)
- 2.** We want to build thriving communities with better health, education and levels of

employment. (See table 2.)

- 3.** Finally, we want to maintain a healthy environment by creating waterless, carbon-neutral mines and delivering positive biodiversity outcomes. (See table 3.)

What steps can you take today to address climate change by 2030?

There are two principal levers through which we can achieve this ambitious goal: improved energy efficiency and reduced greenhouse gas (GHG) emissions. In terms of our goals, we are committed to reducing our GHG emissions by 22 percent relative to the Business-As-Usual (BAU) projection by 2020; and reducing energy consumption by 8 percent relative to the BAU projection by 2020. We will also reduce net GHG emissions by 30 percent and improve energy efficiency by 30 percent by 2030.

It’s important to note that, for each site, we are developing five-year local custom-made plans. We will be targeted and specific in the steps we take, depending on the specific context of the mine itself.

On site and in our business units, a central aspect of our approach to achieve these targets

Anglo American Sustainability Goals 2030

TABLE 1  **TRUSTED CORPORATE LEADER**

Accountability

Local

2020: Establish participatory accountability forums at every mine site (local stakeholder engagement forums)

2025: High-quality dialogue and programs flowing from the forums

2030: Establish multiple levels of open and accountable dialogue leading to greater mutual trust

National and international

2020: Buy-in from BUs, governments and civil society to taking part in national and international stakeholder accountability forums; and general agreement on benchmarks/indices and responsibilities that can be monitored year-on-year including the SDGs

2025: An active and ongoing dialogue about reporting and responsibilities with external recognition that this is a step above other such processes

2030: Widespread recognition of the benefits that responsible mining can bring, a collaborative openness about the challenges and a more consensual working relationship between Anglo American and society (increase/improve by 100 percent)

Policy advocacy

2020: Finalize Group and BU/country policy advocacy action plans in support of key sustainability issues. Provide scholarship opportunities for policy-makers in regions in which we operate

2025: Regular Anglo American involvement in priority policy and governance debates

2030: External recognition of our leadership on policy advocacy; strong levels of engagement in policy debates

Ethical value chains

Mine certification

2020: Half of Anglo American operations to undergo third-party audits against recognized responsible mine certification systems

2025: All Anglo American operations to undergo third party audits against recognized responsible mine certification systems

Responsible sourcing

2030: Responsible sourcing standard fully implemented across Anglo American. Advocate for the development of a common responsible sourcing standard for the mining industry

TABLE 2  **THRIVING COMMUNITIES**

Education

2020: Baselines and strategies to achieve targets in place at every site

2025: Schools in host communities to perform within the top 30 percent of state schools nationally

2030: Schools in host communities to perform within the top 20 percent of state schools nationally

Health and well-being

2020: Baseline established and strategies in place at every site to achieve the SDG3 health targets

2025: Operations to be halfway to closing the gap between baselines and 2030 targets

2030: SDG3 targets for health to be achieved in our host communities

Livelihoods

2020: Baselines and strategies to achieve targets in place at every site

2025: Three jobs created/supported off-site for every job on-site

2030: Five jobs created/supported off-site for every job on-site

TABLE 3  **HEALTHY ENVIRONMENT**

Biodiversity

2020: Net positive impact (NPI) methodology, biodiversity value assessments and site-specific indicators in place at sites in high-risk environments

An established biodiversity framework, supporting processes, capacity and resources in place to enable rigorous application of the mitigation hierarchy across the mining life cycle

Formalize partnerships to support NPI, which are aligned with existing regional and national biodiversity stewardship initiatives

2030: Deliver NPI on biodiversity across Anglo American

Water

2020: Reduce the abstraction of freshwater in water-scarce regions by 20 percent

Increase water-recycling levels to 75 percent

No Level 3 or greater water incidents

2030: Reduce the abstraction of freshwater in water-scarce regions by 50 percent

Site-level targets are being established

Climate change

2020: Reduce greenhouse gas (GHG) emissions by 22 percent relative to the Business-As-Usual (BAU) projection

Reduce energy consumption by 8 percent relative to the BAU projection

Implementation of four priority projects to meet 2030 targets

2030: Reduce net GHG emissions by 30 percent

Improve energy efficiency by 30 percent

Site-level targets are being established



Employing local talent is one essential aspect of Anglo American's Global Sustainability Pillars.

is the energy- and carbon-management (ECO2MAN) program, which we have been implementing across the Group since 2011. The program is centered on site-level energy and GHG reduction targets, which constitute a reduction against current business plans.

The targets consider variable operating conditions, such as changes to mine plans, production levels, the depth and grade of orebodies, and haul distances, as well as acquisitions or disposals. In addition to this program, our sites also have fuel consumption reduction opportunities within operations.

At Group level, we are currently identifying renewable energy opportunities across the Group portfolio, as well as identifying and ranking specific opportunities to meet the 2030 targets. The 2030 targets address a core strategic risk for mining companies to respond to modern society's expectation that we take a leading role on climate change, as well as avoid the costs of climate change by reducing our emissions and improving our energy efficiency.

Anglo American has taken decisive steps for more than a decade to contribute to global efforts to reduce emissions while continuing to provide the materials that modern life requires.

What do you look for in a partner and how do you ensure they are accountable for the promises they make?

Within Anglo American, our supply chain has embarked on a three-year journey to Innovate Supply, Responsibly through breakthrough outcomes in safety, people, sustainability, value delivery and digitization. Underpinning these outcomes are our supplier partnerships.

Our commitment to partnership is not a "nice to have" or a result of doing business. It is at the core of our values, it is central to how we think and it is at the heart of how we conduct and talk about our business. We look for partners that are aligned to our vision of zero harm, and our expectation of all suppliers is to operate safely, responsibly and sustainably in accordance with the policies, codes and standards of Anglo American.

We acknowledge that our strategic supplier partners typically operate in similar environments to ourselves, engage with a diverse range of suppliers, and share similar commitments to sustainability outcomes. In identifying and working with these partners, we are able to drive more progressive and scalable programs.

To this end we actively seek out and collaborate with supplier partners in order to support sustainability outcomes. An example of this collaboration includes our Inclusive

Procurement approach where we work with key partners to direct both their and Anglo American's procurement spend to benefit businesses located within mining host communities. Linked to this, we encourage key supplier partners to focus efforts toward building supplier capacity, strategic social investment and the creation of subsequent employment opportunities around mining host communities, thus broadening the benefits that mining brings.

Our responsible sourcing approach provides a mechanism to prioritize ethical decision-making when we purchase goods and services. Through this program, we work in partnership with suppliers to identify and address wider sustainability issues such as safety, human rights, modern slavery and workplace conditions.

We use several mechanisms to enable tracking of commitments including a Global Framework agreement, which supports us to drive commercial value, cover technical initiative road maps, agree relationship governance and facilitate strategic dialogues. We complement this with a supplier performance approach which allows us to measure, monitor and follow up on key issues in a systematic way with strategic suppliers to ensure minimal disruption in the achievement of mutual commitments and sustainability outcomes. ■

Block cave economics

KAMLOOPS, BRITISH COLUMBIA. An automated loading solution has enabled Canada's only block cave mine to mitigate mud rush hazards and improve productivity – and it paid for itself in less than two months.

TEXT: ERIC GOURLEY PHOTO: ADAM LACH

TONNAGE IS TANTAMOUNT to profitability at New Gold's New Afton mine in south-central British Columbia. The mine has moved and milled as many as 22,000 metric tons of ore in a single day and routinely extracts 18,500 from Canada's only block cave.

Like other prolific block caves, New Afton enjoys enviable efficiency at extremely low operating costs. But the mine has also had to conquer one of the biggest block cave challenges: mud rush.

Mitigating mud rush hazards was the major motivation for implementing automated loading at New Afton. As the block cave grew, more and more drawpoints became finely fragmented and wet. By 2016, one in five drawpoints were assessed as high risk. To ensure operator safety, New Afton stopped manual mucking in those drawpoints and

implemented line-of-sight tele-remote loading.

"When 20 percent of your ore source needs to be remotely mucked, you run the risk that you can't supply your mill with adequate tonnages," says mine manager Peter Prochotsky, who joined New Afton in 2009 as a mining engineer and has seen the operation grow from a development project into Canada's highest-tonnage underground mine. "The line-of-sight systems just weren't keeping up with the growing production demand over the years and we needed a new way of doing things."

NEW AFTON CONDUCTED an engineering study in late 2016 to assess the potential value of implementing automated production loading to overcome the production constraint caused by







Dealing with mud rush hazards was a major motivation for implementing an automated solution at New Afton.

line-of-sight and further improve safety. The mine trialed an AutoMine-equipped Sandvik LH514 for one month in early 2017. Although the 14-metric-ton loader proved too long for some of the cave's tighter turns, New Afton estimated impressive cycle times and buckets per shift for a smaller Sandvik LH410 based on the trial performance of Sandvik LH514.

"To transition from a line-of-sight solution to an automated solution, we calculated a 54-day payback period," Prochotsky says. "If we continued using line-of-site tele-remotes, that production loss was essentially, over 54 days, the value of a brand new Sandvik LH410. And we obviously made the choice pretty quickly that it was the right way to go."

NEW AFTON'S EXISTING block cave extraction level layout wasn't optimized for automation. Two dedicated colleagues worked hand in hand to champion the project, implementing the system and building operator buy-in.

Bob Garner, a technical expert with decades of block cave experience, led the operational side and trained operators on the AutoMine system.

Electrical instrumentation technician TJ Williams complemented Garner's skills with technical expertise, handling installation of all electrical systems.

"We needed to figure out the infrastructure, figure out the Wi-Fi, where we were going to put antennae points, how far apart they had to be, and then teach the loader its path and dial everything in to get it running efficiently," Garner says.

SANDVIK PROVIDED INITIAL engineering assistance, starting system implementation in the west cave that Williams was able to replicate himself in the east cave.

"The infrastructure is relatively simple," he says. "Sandvik provided excellent documentation that we followed to a 'T' and I picked things up along the way working with their engineers. The overall process of installation was pretty straightforward."

Within a week of commissioning in late 2017, the first of the mine's two automated Sandvik LH410s was already proving significantly more productive than the tele-remote solution.

Williams says most of the mine's line-of-sight operators were comfortable running AutoMine within five days.

"The Sandvik automated loaders are much more technologically advanced than the competitor loaders featuring aftermarket line-of-sight, but the learning curve wasn't steep," he says. "Everybody picked it up really easy."

NEW AFTON HAS used its Sandvik LH410s for production mucking on the mine's extraction level, one of the block cave's five main underground levels. The average tram distance between drawpoint and ore pass is only 250 feet, limiting automation's benefits.

"The longer the distance from drawpoint to ore pass, the faster the loader can tram and complete a cycle and the greater the value of automation," Prochotsky says.

Despite the limitations created by the level's short trams, the automated Sandvik LH410's cycle time is almost twice as fast as the mine's line-of-sight loaders. Manual mucking is still faster in the areas New Afton can use it, but the automated Sandvik LH410's lower downtime and higher utilization





With the help of Sandvik engineers, electrical instrumentation technician TJ Williams handled installation of all electrical systems.

NEW GOLD

Canadian-focused intermediate miner New Gold operates the New Afton mine in British Columbia and the Rainy River mine in Ontario. New Gold also owns 100 percent of the Blackwater project in British Columbia and operates the Cerro San Pedro mine in Mexico, which transitioned to the reclamation phase in 2018. New Gold produced 315,483 ounces of gold and 85.1 million pounds of copper from continuing operations in 2018.



Bob Garner led the training of operators on the AutoMine system.

compensate for its modestly higher cycle time.

“At the end of the day, the tons moved by a manual loader and an automated loader are very similar,” Prochotsky says.

ON TOP OF recouping the investment cost of the automated loader in less than two months of operation, New Afton has experienced equipment

health benefits on its bottom line. AutoMine steers the loader with pinpoint precision and its collision avoidance features help eliminate damage while enabling high speeds that accelerate overall cycle time.

“We used to do about CAD 10,000 of collision damage per loader per month, directly related to operating our line-of-sight loaders in a tight environment,” Prochotsky says. “This

cost has dropped to zero thanks to AutoMine.”

THE MINE HAS also realized a 30 percent increase in tire life on the automated Sandvik LH410s compared with the mine’s other 10-metric-ton loaders.

After successfully managing the step change from line-of-sight to automated loading, and improving mucking efficiency while mitigating mud rush hazards, New Afton started thinking bigger.

For the first 18 months, operators oversaw the automated Sandvik loaders from two underground control rooms. New Afton recently finalized a permit amendment process with British Columbia’s Ministry of Energy, Mines and Petroleum Resources to allow the mine’s operators to run AutoMine from a third chair on surface, eliminating travel time and enabling automated mucking through shift change.

“We think that’s really going to enable us to unlock the productivity benefits of automation,” Prochotsky says. “The gains we expect to see from this change should more than close the narrow gap between manual and automated mucking productivity.”

WHILE NEW AFTON focused almost solely on production during 2018, the mine has also recently restarted development to access a new zone that is expected to extend mine life to 2030. New Afton must maintain the same



The automated Sandvik LH410’s cycle time is almost twice as fast as the mine’s line-of-sight loaders.

We're fortunate that we brought the AutoMine system in at really the perfect time for us



18,500-metric-ton daily output despite three fewer operating hours due to twice-daily blasting. Running AutoMine from surface enables New Afton to solve this challenge, too.

“We’ll keep our block cave productive by using an automated loader to muck our development rounds through blast clearing delays,” Prochotsky says. “If we can save 90 minutes in each shift, that’s a huge efficiency gain that also de-risks the project.”

PROCHOTSKY CONTENDS NEW

Afton couldn’t have implemented automated loading at a more ideal time.

“The opportunity to take your learnings and put them into action happens infrequently in block cave mines, as a new level is only developed every five to 10 years,” he says. “We’re fortunate that we brought the

AutoMine system in at really the perfect time for us, to learn how to use it for maximum benefit and position ourselves to take full advantage of it in future mine design.”

For New Afton, AutoMine has proven to be the complete automation solution that management assessed it to be.

“If another mine manager came to me and asked me who they should automate with, I think that Sandvik has the best system on the market, and it’s really because they have the total package,” Prochotsky says. “They’ve got field service representatives available to come to your site to help train your people, they’ve got great safety documentation that allows you to make sure there won’t be any incidents or accidents underground, and they’ve got a product that works. It’s a pretty simple solution in my mind.” ■

NEW AFTON MINE

Located approximately 220 miles northeast of Vancouver and six miles from regional hub Kamloops in south-central British Columbia, the New Afton underground mine occupies the site of the historic Afton open pit mine, which Teck Resources operated from 1977 to 1997.

An exploration company took over the site in 1999 and investigated the feasibility of a block cave mine under the old open pit. Through mergers, that exploration company became New Gold. Development of New Afton began via decline ramp in 2007 and the mine reached commercial production in 2012.

The mine, which employs a workforce of approximately 450, produced 77,329 ounces of gold and 85.1 million pounds of copper in 2018.

SANDVIK LH621i



REDESIGNED FOR THE DIGITAL AGE



Using customer input and with an eye toward automation, Sandvik Mining and Rock Technology has updated its flagship Sandvik LH621 loader for rapid mine development and high-capacity production to help customers overcome their challenges.

TEXT: TURKKA KULMALA PHOTO: SANDVIK





Sandvik LH621i is designed to quickly clear headings, ensuring rapid development.



BENEFITS

- Safety and ergonomics: new spacious air-conditioned ROPS/FOPS-certified cabin
- Productivity: superior hydraulic power for fast bucket filling and drivetrain power for high ramp speeds and rapid advance rates
- Cost-effectiveness: shock-resistant, well-protected structures and efficient cooling for long component lifetimes
- Automation ready: compatible with advanced AutoMine and OptiMine systems for real-time visualization, analysis and optimization of mining production and processes
- Sustainability: excellent overall energy efficiency, longer component lives, Tier 4F/Stage IV engine option

INCLUDING PREDECESSOR MODELS from the yesteryears of the Toro brand, Sandvik LH621 has proven productive in demanding mucking applications for several decades.

In 2015 it became clear to the experts at Sandvik's loader and truck plant in Turku, Finland, that their flagship Sandvik LH621 needed a facelift and new intelligent solutions to tackle the challenges of increasingly connected and digitalized mining ecosystems.

The result, Sandvik LH621i, provides a matching pair with the previously introduced Sandvik TH663i truck. The two forge yet another link in the Sandvik i-series of intelligent underground mining equipment that includes Sandvik LH517i loader and Sandvik TH545i and Sandvik TH551i trucks.

"We started out with our customers," says Olli Karlsson, product line manager, large loaders at Sandvik Mining and Rock Technology. "We asked them first what would best serve their needs: Would they like to have a totally new machine made from scratch, or should we rather start with the

existing loader, keep what is good and update where needed?"

It all started when Sandvik arranged a series of load and haul workshops in a key mining market in the southern hemisphere. Both management representatives and first-line operators participated in the sessions to ensure a balanced overall view. Feedback from other markets was also factored in. The result was unequivocal: Let's start with the existing machine and make it even better.

THE DESIGN TEAM put serious effort into the digitalization readiness of Sandvik LH621i. In the bigger picture, this means optimized compatibility with the company's AutoMine mining automation system. The AutoMine option can be built into the loader from the outset as well as retrofitted in a couple of days, thanks to integrated sensors and quick connectors that are part of the standard configuration. The Knowledge Box onboard Sandvik LH621i collects, processes

and transfers monitoring data into My Sandvik Digital Service dashboard, which can be accessed via My Sandvik customer portal for visualization of fleet health, productivity and utilization.

Another significant change is the new spacious and ergonomic cabin that largely builds on Sandvik TH663i truck's successful design philosophy. Redesigned leg space and pedal positions significantly improve operator comfort. A new window was added to improve over-shoulder visibility and powerful LED lights to further improve visibility from the cabin. A seven-inch touch-screen color display merges all the main information and alarms in one place, which makes it easier for operators to keep their eyes where they should be: on the road. The ROPS/FOPS-certified cabin is a modern, ergonomic workplace that enables comfortable operation and indirectly also improves productivity.

HIGH PRODUCTIVITY IS one of Sandvik LH621i's fundamental features. The main ingredients for more tonnage per shift include several key areas of the boom and bucket mechanics and hydraulics. The optimized boom geometry increases hydraulic power and enables faster bucket filling and effective handling of oversized boulders. The new hydraulic circuit for the boom and bucket supplies a higher flow and more efficient



TECH SPECS

SANDVIK LH621i

Tramming capacity: 46,000 lbs

Standard bucket: 280 cubic feet

Total operating weight: 130,000 lbs

Standard engine: Volvo TAD1374VE, 375 kW at 1900 rpm

Optimized boom geometry enables faster bucket filling.

bucket-shaking functionality for faster dumping times. An upgraded drivetrain provides more power and higher ramp speeds. In a nutshell, Sandvik LH621i is designed to quickly clear tunnel headings, ensuring rapid development.

ANY PROFITABLE OPERATION requires high productivity and minimized tonnage costs. The load-sensing hydraulics help to reduce heat generation and fuel consumption by providing on-demand pressure and increased efficiency. Cost-effective design is another cost-cutting strategy, and with Sandvik LH621i this means durability-optimized structural solutions, such as a heavy-duty rear frame and mask to minimize impact damage and shock-resistant welded steel box structures in the frame and boom. The rugged structural solutions reduce stresses, extend frame lifetime and provide a superior strength-to-weight ratio. The service

life of key components has been increased by new cooling and brake systems.

Another factor in Sandvik LH621i that has reverberations affecting safety, productivity and sustainability is maintenance friendliness. To start with, the seven-inch color display provides the operator with a clear overview of all key diagnostics and alarm log files, which minimizes the need to move around the loader for troubleshooting. A large number of changes and adjustments were carried out to centralize service access and provide better maintainability and easy access to the components, most of which are reachable from the ground level. Safety rails are available to improve safety when working on top of the equipment.

Underground mine environments can be inherently hazardous. Sandvik LH621i includes numerous features that help ensure operators and maintenance personnel return

home from work safely every day: an ergonomic FOPS/ROPS cabin with optimized visibility, high-power LED lights, ground-level access to maintenance points, anti-slip steps and many more.

SUSTAINABILITY MAY SOMETIMES seem like a buzzword that has little to offer in the way of improving the real-life conditions and practical realities of mining. In Sandvik LH621i, the sustainability benefits are tangible. Productivity engineering and cost-per-ton optimization mesh seamlessly with sustainability targets. Faster bucket filling and dumping cycles, and optimized routes and ore-moving processes at the same time, mean a smaller carbon footprint and fewer emissions.

Excellent fuel efficiency is not only a cost factor – it also boosts sustainability performance. The standard engine in Sandvik LH621i is a fuel-efficient Tier 2/Stage II powerplant. When ultra-low-sulfur diesel fuel is available at the mine site, the low-emission Tier 4F/Stage IV engine can be considered as an option. Sandvik has a staunch commitment to implement the latest engine technologies when available and thus comply with regulations.

The sustainability thinking behind Sandvik LH621i focuses on tangible factors that have significant bearing on the operators' and maintenance crews' everyday work and the measurable sustainability performance of the mine. "Our approach is very practical," Karlsson says. "We make a good machine, look at it from every angle and optimize all the relevant characteristics to achieve tangible real-life benefits." ■

Automation transformation

NAVAN, IRELAND. An automated approach at an unusual orebody is helping Boliden Tara offset declining grades while increasing productivity and improving safety and sustainability at Europe's largest zinc operation.

TEXT: **JEAN-PAUL SMALL** PHOTO: **SAMIR SOUDAH**

FOUNDED IN 1147 and just a few minutes' drive south of the quaint town of Navan in Ireland sits the Bective Abbey, an amazingly well-preserved gray stone Cistercian church that has graced the Emerald Isle's countryside for centuries. The sprawling site is a tribute to strong foundations and ingenious design, both of which have helped the old structure stand the test of time. Drive a little westward from town and you'll find Boliden's Tara mine, a testament to similarly shrewd planning and one that looks to replicate the longevity displayed by the abbey while remaining productive in an ever-challenging market.

Commissioned in 1977 and with annual production of 2.6 million metric tons of ore, Tara is Europe's largest zinc mine despite a relatively distinct orebody. "The dip of the orebody is challenging in that it is a shallow dipping orebody," says Tara mining manager Tom Bailey. "That means from a productivity point of view there's a lot of development that we need to continue to access the orebody. Where the orebody is thick it's still well suited to longhole open stoping, but where it gets somewhat shallower the

challenges increase."

And here at Tara challenges abound. The company's target of around 2.6 million metric tons of ore annually depends on stope availability, which itself depends on 8.9 miles of development per year. "We're looking at only 112 metric tons of longhole production ore accessed per meter of development," Bailey says. "That's quite a high ratio of development meters to production ore."

DECLINING GRADES ALSO add to the list of hurdles Tara must overcome. When the mine was commissioned in 1977, zinc grades were around 12 percent. "The grades we're mining now are much lower," Bailey says. "Last year it was 6.3 percent, this year it's going to be 5.7 percent, and in the future we expect it to drop to 5.3 percent. So our return per ton of rock mined in terms of metal content is decreasing, which obviously affects our profitability. You really need to offset that in some way, and we've focused on improved productivity and reduced cost to deal with those declining grades."

Gerry McDonagh is head of mine production at Tara mines, and it's his job to make those offset goals a reality. "We approach our objectives by trying to bring in the best technology, methods and people to realize our vision," he says. For the team at Boliden, that includes an automated solution provided by Sandvik.

"When you look to introduce anything into your mining environment, you assess it from a holistic viewpoint," McDonagh says. "We looked at it for the productivity it provides, sure, but also the safety and health benefits as well."

BAILEY CONCURS. "WHEN I think about productivity, I think of increased utilization of the equipment, which reduces your capital requirements," he says. "Increasing volume at the same cost is also huge for us, and some of it comes from the use of automated trucks and loaders over shift change, for example."

Tara started to think about automation in 2011, visiting other mines, such as Kidd Creek in Canada, which was far progressed in its loading and hauling automation





Remote operator Paul Finnegan controls his equipment from the control room above ground.



Automation has helped Boliden Tara increase utilization, which has reduced its capital requirements.



Tara mine has invested in a fleet of automation-ready load and haul equipment.

BOLIDEN

Boliden's open pit and underground mines are some of the world's most productive. The company continually develops new techniques and methods of exploiting resources in the best possible way and invests heavily in maintenance technology. Boliden works constantly to modernize and streamline the design, planning and management of its mines in Sweden, Finland and Ireland to further raise quality.

solutions. By 2015 the mine began automated trials in a closed, dead-end area of the mine to determine the feasibility of the system. When the trials proved effective, the next step was identifying the best possible places to implement the system to maximize the return on investment. For Tara, that meant its mucking operation where the mine could typically load directly from a stope into a truck or into an ore pass.

"It's still been a bit of a learning curve for us," McDonagh says of the

automation journey. "We had to learn how to set it up properly first, and of course we made mistakes. Then we had to convince our 580 employees that not only would they not lose their jobs, but they'd be made easier, so it's been a challenge, no doubt.

"We once had an incident where an operator passed by the laser gate and all the equipment shut down," he says. "That experience, as much as we didn't want it to happen, was a benefit as people realized the system works. Automation has also amalgamated certain job roles, freeing people up to help out in other areas and make us more efficient."

TARA HAS PURCHASED one Sandvik DD422i jumbo and two electric Sandvik DD422iE rigs, all of which have a high degree of automation in terms of their drilling accuracy, maximizing their advance per round. "Typically, we get around 4.5 meters per round, and on straight drives we're getting more than five meters per round with those rigs," Bailey says. "In addition to that, the rigs have auto

drilling, so quite often over lunch we'll leave the face drilling on auto. This gives us better assurance that we're getting that development round done in a given shift."

Along with the three intelligent Sandvik jumbos, Tara has invested in a fleet of automation-ready load and haul equipment, including three Sandvik LH517 loaders, two Sandvik LH621 loaders and one LH621i loader, as well as one Sandvik TH663i truck. All of these complement another eight underground trucks and drill rigs from Sandvik.

"The automatic operation of the equipment also results in less wear and tear," Bailey says. "Scanners prevent them from hitting walls or objects in the road, which decreases damage and maintenance costs, and because we're increasing utilization we're also reducing our capital requirements."

BY REMOVING PEOPLE from hazardous areas, the company is improving employee safety. Operator Paul Finnegan loves working in the control room above ground. "The benefits of

We approach our objectives by trying to bring in the best technology, methods and people



working with automation are definitely the safety, not to mention you get to enjoy the beautiful Irish weather sitting up top in the control room,” he says with a grin. “And it took only around two weeks of training before I became the expert that I am today.”

THE AUTOMATION journey is not yet over, but the preliminary results are in. “With longhole drilling, the introduction of automation, which will be expanded next year, has already provided a capacity increase of around 15 percent so far,” Bailey says. “In terms of utilization, particularly where there is a full bottleneck, we’ve done up to 30 percent of our drilling on auto and fully utilized the additional capacity.

“When it comes to trucking and mucking,” he says, “automation has

increased capacity with one truck, with another ordered already for next year, by around 10 to 15 percent by being able to operate over shift change and over blocks that are isolated from the other mining areas continuously during a shift.”

TARA PLANS TO increase that capacity after trials and implementation stages are over. “Today we’ve only been utilizing around 5 percent of the available capacity increase, but with the infrastructure that we’ve installed and the equipment that we’ve purchased the available capacity there will result in around a 15 to 20 percent increase,” Bailey says.

The partnership that Boliden shares with Sandvik is a special one. “We really do work well together,” McDonagh says. “Along with the

amazing service and training, including providing drill masters on-site to ‘up-skill’ our staff and sharpen our bits, Sandvik has provided us with a comprehensive drill consumables contract that is really a joint approach to sharing costs, where consumables are lost or damaged.

“We also send our trainers to the Sandvik Master Driller program, which provides the highest training levels available in the industry,” McDonagh says. “Our trainers bring that knowledge back to the workforce, which in turn improves the operation of all our drilling equipment and reduces our consumable usage. We even trial new equipment for them, and we’re the first company in Europe to get the Sandvik LH621i loader, which is evidence of the trust we have in each other.”



Sandvik supplies drill consumables through a comprehensive contract at Boliden Tara.



Tara mining manager Tom Bailey.



TARA MINE

Boliden's Tara mine in Ireland is Europe's largest zinc operation and one of the largest in the world. Since mining began in 1978, more than 85 million metric tons of ore have been extracted. Boliden acquired the mine in 2004. Thanks to exploration and acquisitions, the mineral reserve and mineral resources have grown continuously. In recent years, Tara has focused on improving its cost position through productivity-enhancing investments and savings measures. Around 2.6 million metric tons of ore are mined annually for the production of zinc and lead concentrates.

The two companies are also engaged in a similar partnership when it comes to automation. Sandvik on-site specialists are there to assist in the automation journey, to ensure all of Boliden's goals are met from a productivity, safety and sustainability standpoint.

"The production targets here at Tara are defined on the quality of their productivity," says Brian Carroll, Sandvik Mining and Rock Technology parts, service and warranty manager in Ireland. "Their

productivity is dependent on the quality of the equipment, and the quality of the equipment requires good service. Our on-site maintenance and automation teams really try to provide the best service to Tara to keep them on track to meet all their standards of success."

BOLIDEN IS AN industry leader when it comes to sustainable operations, and it invests heavily in energy-efficient initiatives, from spending a million euros to upgrade its underground

water system to rehabilitating its tailings dams so that livestock can be grazed. Automation is another key cog in the sustainability focus for the company, one that they are maximizing with their partnership.

"I think Sandvik and Boliden Tara both understand that if we take a partnership approach, there will be mutual benefits derived for both companies," Bailey says. "And that's the kind of partner that will help us stay productive for the life of the mining operations here at Tara." ■

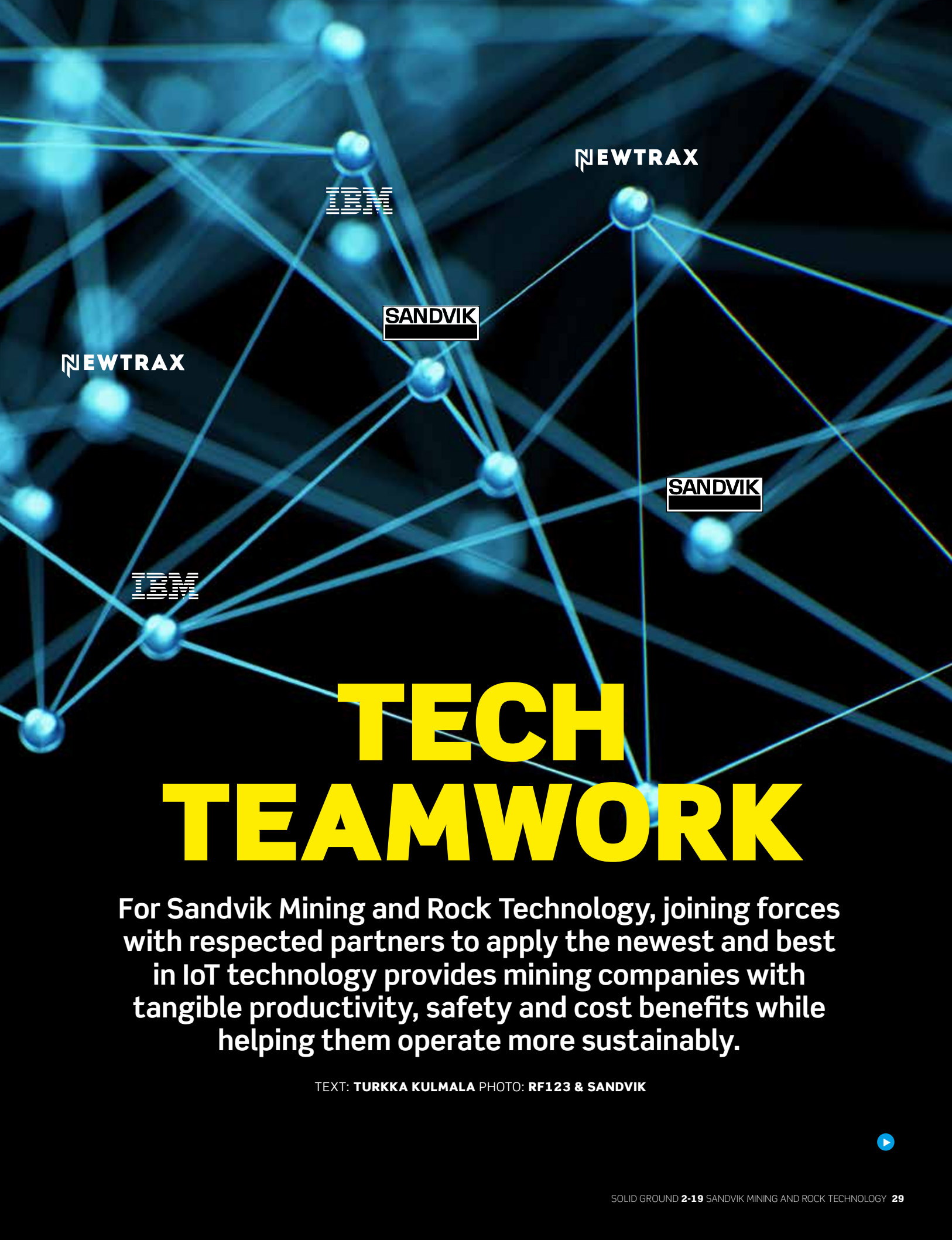
SANDVIK INTEROPERABILITY

IBM

SANDVIK

NEWTRAX

SANDVIK



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TECH TEAMWORK

For Sandvik Mining and Rock Technology, joining forces with respected partners to apply the newest and best in IoT technology provides mining companies with tangible productivity, safety and cost benefits while helping them operate more sustainably.

TEXT: TURKKA KULMALA PHOTO: RF123 & SANDVIK



Sandvik Mining and Rock Technology systems will be able to interface with other systems via the company's interoperability policy.



SANDVIK AND NEWTRAX

The companies announced their partnership aimed at delivering world-class mining safety, efficiency and productivity to underground metal mines through digitalization in November 2018, and the letter of intent on an acquisition was signed in April 2019.

Headquartered in Montréal, Canada, Newtrax will be run as an independent business unit within the division Rock Drills & Technologies in the business area Sandvik Mining and Rock Technology. The transaction was closed in the second quarter of 2019.

FOR MINING COMPANIES looking to harness the power of data from all their automation and data collection systems, OptiMine Analytics helps turn that data into actionable knowledge to support decision making. It merges data from various sources, including the My Sandvik fleet monitoring system and other components of the OptiMine software suite, such as location tracking, task management and scheduling tools, as well as any third-party systems that the mine may use to track and manage its operations. OptiMine Analytics combines all of

these data flows and integrates with other IT systems via open application interfaces.

Sandvik has teamed up with IBM to supply OptiMine Analytics with truly powerful predictive capabilities. Whereas OptiMine Analytics merges the communication with various data flows and mining equipment operating underground, the IBM Watson IoT system provides the analytical and machine learning capabilities that make predictive maintenance and optimization a reality.

Now the time has come to take the next step, in line with the principles of Sandvik's data interoperability policy, which states that Sandvik systems are based on open architecture. While data from Sandvik equipment can be read directly from the machines via predefined interfaces, the data is also available for reading at the server level. Sandvik systems can read and utilize data from third-party systems and, conversely, data from Sandvik systems can be used in third-party systems.

A good example of what Sandvik's interoperability policy means

practically is the recent acquisition of Newtrax Technologies Inc. and the vendor independence that Newtrax technology brings to Sandvik's digital offering.

NEWTRAX TECHNOLOGIES IS the global leader in wireless IoT and the preferred source of big data for AI for underground hard rock mines, offering safety and productivity solutions through the monitoring of people, machines and the environment. Newtrax complements OptiMine with wireless IoT solutions to extend the sensor capabilities and to add data collection elements that can be integrated with OptiMine. If OptiMine is the brain of the data analytics solution, Newtrax extends its nervous system with new sensing capabilities.

Practically speaking, what does this bring to the table? One new benefit is the ability to integrate third-party equipment with the system, creating a solution that is independent of a specific OEM supplier, including Sandvik itself. Telemetry and tracking data from a non-Sandvik drill rig, for example, can now be seamlessly

imported to the OptiMine environment and combined with other sources of data.

Proximity detection is an example of the benefits Newtrax brings to the table. The patented technology has been developed specifically to reduce the risk of collisions between light and heavy vehicles as well as pedestrians in underground hard rock mines by eliminating blind spots around mobile mining equipment. With this technology integrated in every underground miner's cap lamp, people can request emergency stops when vehicles appear in harm's way, and a fall detection feature system recognizes unconscious workers by detecting that their cap lamp has not moved at all for a specified length of time.

PERSONNEL AND EQUIPMENT tracking is another way Newtrax technology can improve mine safety, particularly for people working alone. By connecting to any network infrastructure in an underground mine, the sensors placed on the personnel's cap lamps and on the vehicles send location signals to the surface, so that lone personnel are safe at all times and

SANDVIK INTEROPERABILITY POLICY

Sandvik Mining and Rock Technology has instituted its data interoperability policy, which specifies how Sandvik systems, equipment and tools share data in the mining digital ecosystem. The policy outlines the principles by which Sandvik systems can communicate in a digitalized mining and rock excavation industry. These systems will be able to interface and exchange data with other systems around the operation, ensuring that the value of the data can be unlocked.

vehicles are easily retrievable at start of shift.

In addition to personnel and equipment safety, Newtrax also provides early detection of hazards related to ground displacement, mine air quality and water-level monitoring. The system integrates various instrumentation devices, such as pressure monitoring instruments, settlement sensors and piezometers for water level monitoring, and merges the data in simple dashboards for a clear overview and to enable potential corrective measures. For example, ventilation by auxiliary fans can be switched on as needed.

Improved safety is not the only benefit of the Sandvik-Newtrax

partnership. The combined offering provides the potential to improve sustainability, increasing the productivity of underground mines through more efficient use of resources. Better control of the mining equipment enables more accurate planning and ultimately increases the tonnage produced in each shift.

Newtrax technology also cuts expenses by assisting mines to avoid unnecessary work and vehicle traffic, which saves fuel and maintenance costs and also helps to reduce exhaust emissions. While lower emissions provide crucial environmental and health benefits, they may also help to achieve indirect cost savings by reducing ventilation needs. ■



The acquisition of Newtrax Technologies adds another layer of wireless IoT access to OEM-independent OptiMine.



AN ELECTRIC FUTURE

As mining companies around the world seek the best ways to approach their sustainability goals, electrification has emerged as one of the most promising solutions. With this in mind, Sandvik Mining and Rock Technology recently acquired California-based Artisan Vehicle Systems, a leading manufacturer of battery-electric underground vehicles.

Text: **ISABELLE KLIGER** Photos: **SANDVIK**



Companies across the industrial spectrum are embracing the shift away from fossil fuels.

RECENT STUDIES SHOW that the electrification of a mine has the potential to reduce energy costs by up to 25 percent in existing operations, and as much as 50 percent in new mines. Looking to the future, electric power is set to become even more affordable, with the cost of renewable electricity from solar and wind power technologies projected to fall by as much as 59 percent by 2025, according to the International Renewable Energy Agency (IRENA).

Mike Kasaba, managing director, Artisan Vehicle Systems, a Sandvik Mining and Rock Technology business unit, says electrification

5 REASONS WHY ELECTRIC MINES ARE LESS COSTLY

- Ventilation systems can be reduced by 30 to 50 percent
- Less ventilation translates to reduced electricity use
- No diesel fuel costs
- Electric vehicles require less maintenance
- Electricity from renewable energy is becoming more affordable

has the potential to disrupt every industry in which mobile equipment is used. Looking across all segments, development efforts are currently under way with virtually every manufacturer of vehicles or other mobile machines. Why is this? Kasaba says it comes down to the simple fact that the customers who use these machines are demanding it.

“Regardless of whether these customers are individuals, construction firms, government fleets, trucking companies, ports or mining and tunnelling organizations, what the vast majority of them have in common is that they are embracing a fundamental shift in technology away from fossil fuels,” Kasaba says.

REDUCING DIESEL EMISSIONS to zero makes the underground working environment safer for the miners while ensuring that emissions are not vented into the environment. But beyond the safety aspect and the obvious environmental benefit to the planet, Kasaba explains that electric mines also deliver advantages in terms of economy, productivity and performance.

“As the cost of this new technology decreases and the range, reliability and performance increase, electric drive systems are starting to outperform fossil fuel systems

on overall cost of ownership, competitive advantage, return on investment and driver preference,” he says. Many of these new mobile machines are being built from the outset with future technological advancements in mind. “They are ready for remote upgrades, range performance improvements and more,” he says.

WHEN IT COMES to the all-important economic arguments, a mine site stands to benefit in several ways from electrifying its mobile fleet. The cost of the ventilation systems, one of the most expensive aspects of developing and operating a mine, can be reduced by anywhere from 30 to 50 percent when using battery-electric machines that produce zero diesel emissions. Furthermore, less ventilation translates to a net reduction in electricity use and therefore a more energy-efficient mine site overall. Meanwhile, the eliminated cost of buying diesel fuel equates to tens of thousands of dollars in savings – per vehicle and per year. Maintenance costs are also reduced, since electric vehicle propulsion rigs have around 25 percent fewer parts than diesel propulsion rigs.

Battery-electric machines produce one-eighth of the heat produced by a diesel machine, which can make new projects in deep mines, and mines with active geothermal conditions, more viable than they would otherwise be, due to the reduced heat factor. Last but not least, regulatory bodies are gradually starting to favor mines that commit to an all-electric underground environment, resulting in approvals for permits that would otherwise be denied, along with a faster permitting process, both of which are potentially game-changing for mining companies around the world.

FOR ITS SIZE, an electric motor has far more power and torque than a combustion engine. Since total horsepower does not have to be limited to mitigate ventilation system costs,

The fact that zero diesel emissions are inherently healthier and safer for mine site workers makes electrification inevitable

far more power can be packed into a smaller machine. As a result, battery-electric machines can be designed from the ground up to handle more torque and power and therefore increase productivity in any given machine size class.

ALTHOUGH THE ADVANTAGES of electric mining speak for themselves, the industry is taking time to adapt. However, Kasaba says change is in the air.

“There are no obstacles preventing the use of electric,” he says. “The machines are at least as productive as diesel machines, the overall costs are lower, and batteries and electric components are being made in high volumes so production is scalable.” He adds that throughout modern history most technological advancements that have offered greater productivity, environmental, health and other benefits have tended to come with trade-offs such as increased costs, but this is not the case with electrification.

“The view is that, in the case of the electrification, overall costs will be lower,” Kasaba says. “This, coupled with the fact that zero diesel emissions are inherently healthier and safer for mine site workers, makes electrification inevitable.”

As a leading supplier to the mining industry, Sandvik Mining and Rock Technology has been quick to recognize the huge potential benefits of electrification. In February this year, Sandvik completed the

Sandvik Mining and Rock Technology offers a host of electric equipment, including Sandvik DD422iE development drill rig.



THE BENEFITS OF ELECTRIFICATION OF MINES INCLUDE:

- Energy costs reduced by between 25 and 50 percent
- Safer working environment due to zero diesel emissions
- Reduced environmental impact due to zero diesel emissions
- Regulators are starting to favor all-electric mines
- Battery-electric machines offer enhanced productivity, performance and efficiency

acquisition of Artisan Vehicle Systems to secure access to its cutting-edge technologies and solutions, which include proprietary battery packs, electric motors, power electronics, software and control systems for hard rock underground mining.

MATS ERIKSSON, PRESIDENT of Sandvik Mining and Rock Technology’s Load and Haul division, says this is a logical step in complementing the market-leading competence and experience that already exists at Sandvik’s state-of-the-art battery-electric vehicle and electrification research center at the Load and Haul facility in Turku, Finland.

“Artisan is a front-runner in electric vehicle development, and Sandvik’s new R&D foothold in this area will complement the know-how and skills we already have from developing and making world-leading loaders and trucks,” Eriksson says, adding that the acquisition is advantageous to both parties. While Sandvik will benefit from Artisan’s quick, agile approach to innovation and battery-electric vehicle expertise, Artisan will gain access to the established strength and operational experience of Sandvik, which has been the market leader in tethered electric

underground loaders since 1981.

“The acquisition of Artisan battery-electric vehicles places Sandvik in a leadership position in terms of electrification within underground mining, which is clearly the direction in which the industry is heading,” Eriksson concludes. ■

ARTISAN VEHICLE SYSTEMS

Based in Camarillo, California, Artisan is a manufacturer of battery-powered underground mining equipment. It has three commercially available machines: a four-ton capacity LHD (A4), a 10-ton capacity LHD (A10) and a 40-ton capacity haul truck (Z40). Artisan is a start-up company, which in 2017 had revenue of USD 12.3 million and some 60 employees. In February 2019, Sandvik Mining and Rock Technology acquired Artisan in a bid to establish itself as a front-runner in the fast-moving battery-electric mining equipment space. Artisan is a business unit in Sandvik’s Load and Haul division.

GOALS IN FOCUS

Gearing up for 2030

For Sandvik Mining and Rock Technology, a sustainable business strategy means focusing on a full life-cycle approach that will deliver value in its operations, offerings and across its supply chain through four goals for the year 2030: safety, reducing greenhouse gases, circularity and compliance.





CUSTOMERS

- Material and resource efficiency improvement will be part of all development projects.
- We will develop recycling/circularity business models for our customers.

OPERATIONS

- All of our products and packaging material shall have at least 90% material circularity.
- We will cut our waste in half for our production processes.

SUPPLIERS

- We will require 90% circularity for key suppliers.

**WE BUILD
CIRCULARITY**
More than 90% circular



CUSTOMERS

- CO₂ improvement will be part of all product development projects.
- Value propositions to our customers shall always include verified CO₂ reduction potential.

OPERATIONS

- We will cut our CO₂ footprint from our own production and the transportation of people and products in half.

SUPPLIERS

- We will require our key suppliers to cut their CO₂ footprint in half.

**WE SHIFT
CLIMATE**
Halve the CO₂ impact

2030 GOALS & TARGETS

We will lead the shift in our industry and build a successful long-term business that advances the world through engineering. Our aim is to be the innovative business partner for our customers by making sustainability part of every aspect of business, delivering value for everyone. Our full life-cycle approach means we work relentlessly in our operations, across our supply chain and through our customer offerings to drive more sustainable, resilient business.

Sustainability is a natural and integrated part of our business strategy

WE CHAMPION PEOPLE

Zero harm to people



CUSTOMERS

- We will ensure health and safety risk analyses and improvements are part of all product development projects.

OPERATIONS

- We will cut the Total Recorded Injury Frequency Rate and occupational illnesses in half.
- All Sandvik employees to be offered health and well-being programs.

SUPPLIERS

- We will require our key suppliers' health and safety improvements plan to meet Sandvik standards.



WE PLAY FAIR

Always do the right thing

CUSTOMERS

- We will have increased transparency on sustainability targets and results.
- Our Know Your Customer process will lead to sustainable choices.

OPERATIONS

- Our proactive and agile compliance system will be fully embedded within business operations.
- We will create a diverse and inclusive workforce, with at least one-third female managers.

SUPPLIERS

- All suppliers must be compliant with Sandvik Supplier Code of Conduct.

A bit of rejuvenation

“Waste not, want not.” This proverbial saying from the 16th century is, not surprisingly, still relevant in these days of increased awareness of the advantages of recycling. Perhaps even more so, particularly as everyone tries to reduce costs and manage resources, while doing more to protect the environment. Sandvik Mining and Rock Technology recognizes the need to recycle steel and cemented carbide for a variety of reasons, and as such has implemented a comprehensive recycling program that benefits customers as well as the company. For instance, by recycling drill bits containing steel and cemented carbide, energy consumption is reduced by around 75 percent compared with using virgin materials, which reduces CO₂ emissions by around 40 percent. In addition, NO_x emissions are also reduced and the use of hazardous chemicals virtually eliminated. So not only can customers do their part for the environment, but they can also minimize costs and reduce waste. ■





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