

SOLID

#1 2017

GROUND

A MAGAZINE FROM
SANDVIK MINING AND ROCK TECHNOLOGY

Sweden:

**Tough in a
tight spot**

Sandvik CS550:

**Get your
crush on**

Big Picture:

**The way
we were**

**Tripling development pace
in the heart of Kazakhstan.**

EASTERN AMBITION

SANDVIK

Dear reader,

FOR SANDVIK MINING AND ROCK TECHNOLOGY, innovation is at the heart of everything we do – along with our focus on our No. 1 priority, safety. Whether it’s:

- the new Sandvik UNIFACE down-the-hole range of drill bits, providing up to 80 percent longer service life than the previous range (meaning that operators spend less time changing tools),
- the way we’ve teamed up with Goldcorp to develop the world’s first all-electric mine (Borden Lake, Canada),
- or the new Sandvik CS550 cone crusher, offering advanced automation and maintenance features to maximize your uptime – everything we do is designed with you, our customer, in mind.

The above are just some of the things we are doing right here, right now. However, rightly proud though we are of our latest innovations, our focus is already on the future, “Future Tech Today.” We have a team working day in, day out, to ensure that new trends and concepts are incorporated into our product designs to increase their productivity, reduce total cost of ownership and enhance safety and reliability. For example, current developments in

the automobile industry (self-driving cars) are really pushing forward autonomous vehicle technology – with Sandvik AutoMine already having 1.5 million operating hours’ proof of increased safety, improved utilization of equipment and lower operating costs. Green power systems are another big area of focus – such as the battery-operated Sandvik DD422iE mining jumbo and Sandvik LH307B loader.

It’s a fine balance between the “here and now” and the future. We know that for you, our customer, the most important thing is to know that Sandvik is here to help you in your daily challenges, anywhere, anytime. That’s why we strive for continuous improvement in our parts and service offering, tailor-made for your specific challenges.

Find out how you can save on parts and services with the new Sandvik 365 iPad app – with an ROI calculator to demonstrate how you can boost your bottom line.

Sandvik Mining and Rock Technology is there for you in the most demanding of locations and challenges, right here and now – and in the future.



LARS ENGSTRÖM
PRESIDENT, SANDVIK MINING
AND ROCK TECHNOLOGY

SANDVIK NEWS

Supplying Stuttgart 21..... 5

PROFILE

Master blaster 6

TRADE NEWS

Data diamonds 8

ARTEMYEVSKY POLYMETALLIC MINE

Noble machines..... 10

SANDVIK CS550

High capacity and reduction in one...16

SLUSSEN JUNCTION DEVELOPMENT

Precise in a tight spot 20

SANDVIK DU412i

Highly flexible in-the-hole drilling..... 26

INTELLIGENCE

Future talk.....30

SUSTAINING SAFETY

HX900 improves EHS, productivity .. 33

THE BIG PICTURE

Taking it to the top.....36

PRODUCT RANGE

Global solutions and services..... 38

SOLID GROUND is a business and technology magazine from Sandvik Mining and Rock Technology, Kungsbron 1, 111 22 Stockholm, Sweden. Phone: +46 (0)845 61100. *Solid Ground* is published twice a year in English, Chinese, French, Polish, Portuguese, Russian, Spanish and US adaptation. The magazine is free to Sandvik Mining and Rock Technology customers. Published by Spoon Publishing in Stockholm, Sweden. ISSN 2000-2874.

Editor-in-chief and responsible under Swedish publishing law: Jeanette Svensson. **Project leader:** Eric Gourley. **Editor:** Jean-Paul Small. **Sub editor:** Michael Miller. **Creative director:** Niklas Thulin. **Art director:** Linda Klemming. **Language coordination:** Louise Holpp. **Prepress:** Markus Dahlstedt. **Cover photo:** Adam Lach. **Editorial board:** Marie Brodin, Eric Gourley, Conny Rask.

Please note that unsolicited manuscripts are not accepted. Material in the publication may only be reproduced with permission. Requests for permission should be sent to the editorial manager, *Solid Ground*. Editorial material and opinions expressed in *Solid Ground* do not necessarily reflect the views of Sandvik Mining and Rock Technology or the publisher.

Correspondence and enquiries regarding the magazine are welcome. Contact: *Solid Ground*, Spoon Publishing AB, Rosenlundsgatan 40, SE-118 53 Stockholm, Sweden. Phone: +46 (0)8 442 96 20.

Email: solidground@sandvik.com. Distribution enquiries email: solidground@spoon.se Internet: www.minestories.com.

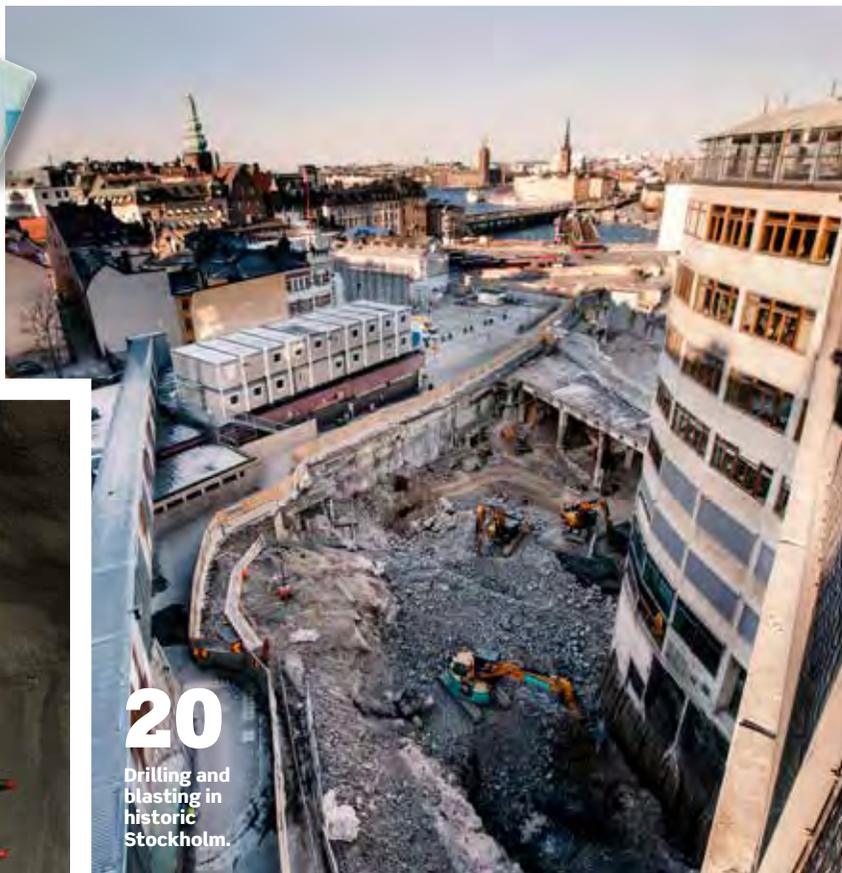
Solid Ground is issued for informational purposes. The information provided is of a general nature and should not be treated as advice or be relied upon for making decisions or for use in a specific matter. Any use of the information provided is at the user's sole risk, and Sandvik Mining and Rock Technology shall not be liable for any direct, incidental, consequential or indirect damage arising out of the use of the information made available in *Solid Ground*.

CONTENTS 1.17



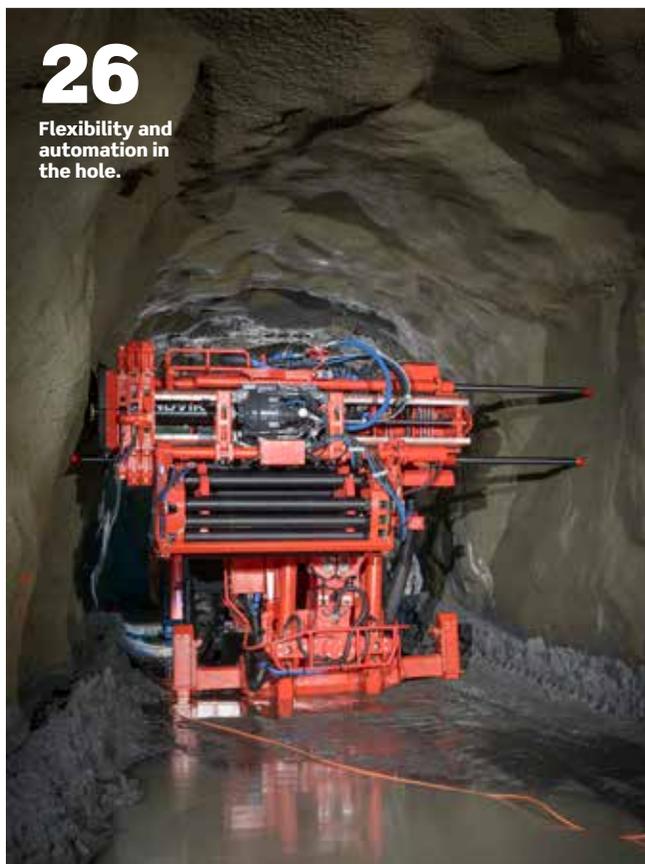
30

Piecing tech together.



20

Drilling and blasting in historic Stockholm.



26

Flexibility and automation in the hole.



10

Proving productive at the base of the Altai Mountains.



16

High-capacity, high-reduction workhorse.

UNIFACE takes centre stage

▶ Sandvik Mining and Rock Technology has launched the new Sandvik UNIFACE down-the-hole (DTH) range of drill bits. With long bit life essential to cutting costs and improving productivity, the service life of Sandvik UNIFACE bits can be as much as 80 percent longer than current Sandvik bits. Sandvik UNIFACE is designed for optimized flushing that gives a more even wear of the gauge, increasing the life of the bit. In order to achieve a consistent penetration rate, the buttons have been placed so that they always hit fresh rock.

The tool life improvements delivered by the Sandvik UNIFACE design also yield significant health and safety benefits, since operators spend less time changing tools.

“The new bit design essentially delivers more drill metres per shift compared with a standard bit, thanks to less frequent bit changes,” says Johan Bergquist, global product line manager DTH tools, Sandvik Mining and Rock Technology. “The result is a design with a number of features that are new to the industry and that significantly increase bit life, while maintaining penetration rate.”



Sandvik scores high on the DJSI

▶ Sandvik Group has once again been selected as a member of the Dow Jones Sustainability Index (DJSI). Only the top 10 percent of sustainable companies worldwide in each industry are included in the prestigious list. Sandvik has achieved a percentile ranking of 98 this year, meaning its performance is better than 98 percent of the assessed companies.

“This is a great achievement,” says Christina Båge-Friborg, Sandvik head of Sustainable Business. “Being included in the DJSI, while strengthening our sustainability efforts every year, shows our customers that we are a responsible supplier striving to help them be more sustainable, too.”



Sandvik DD422iE is part of the all-electric fleet at Borden Lake.

First all-electric mine gets the green light

▶ In a comprehensive attempt to improve environment, health and safety conditions in underground mines, Canada’s Goldcorp and Sandvik Mining and Rock Technology have teamed up to develop the world’s first all-electric mine at the miner’s Borden Lake site near Chapleau, Canada.

The major undertaking is the latest revolutionary measure taken by Goldcorp to remove diesel particulate matter from

underground environments. Sandvik will provide the complete electric solution, including development equipment, which is expected to eliminate all greenhouse gases associated with the movement of ore and waste rock.

“We can provide a full solution for development equipment for the mine because of our breadth of offering,” says Dale Rakochy, business line manager, underground equipment, Sandvik Mining and Rock Technology.

Intelligent performance

▶ Sandvik Mining and Rock Technology has launched Commando DC130Ri, the company’s first intelligent compact-class drill. The rubber-tired top hammer drill rig has a modular design, efficient Sandvik RD106 rock drill and a new intelligent control system.

Commando DC130Ri is a fully remote-controlled, hydraulic and self-propelled unit, designed for drilling 22- to 45-millimetre holes. It possesses the functionality to have rollover for the feed, change drill steels on the rock drill and adjust the drill rig to challenging environmental conditions with additional appliances such as the fuel-powered engine heater. Commando DC130Ri is also equipped with a fuel-efficient, low-emission CAT C2.2 Tier 3 engine.

The drill’s new intelligent control system provides modern machine control features that until now have been found only on larger rigs.

Intelligent engine control provides operating cost savings through lower fuel consumption by optimizing the engine power based on actual requirements.



Commando DC130Ri is a fully remote-controlled, hydraulic and self-propelled unit.

Stuttgart 21 to link millions across Europe

▶ The Stuttgart 21 rail project in Germany is a 1,500-kilometre railway line infrastructure project that, when complete, will help connect 35 million people in five countries, enabling travel from Paris, Strasbourg, Munich and Vienna, and connecting Bratislava to Budapest.

The route will involve the creation of new tunnels, which will provide shorter travel times and offer more direct connections. Contractor Avesco, which has been commissioned by the management consortia, will employ a variety of Sandvik Mining and Rock Technology tunnelling equipment and software to construct the tunnels.

A total of 63 kilometres of tunnels will be

excavated, representing a height differential of 500 metres. Avesco has relied heavily on its fleet of 14 Sandvik tunnelling jumbos and associated equipment. Furthermore, Sandvik dry drilling systems have proved their worth, being the only technique that could be successfully used at the project's Feuerbach Tunnel.

The Sandvik equipment is being operated in conjunction with iSURE, its advanced tunnel management and information analysis software for optimizing drill and blast design. Project costs are kept low, and smooth tunnelling progress is ensured as iSURE provides specific support for the various stages of drilling and blasting processes.

9,000 reasons to celebrate

▶ After 45 years of operation the Sandvik plant in Turku, Finland, rolled out its 9,000th unit, a Sandvik TH663 underground truck, in September 2016. The event was commemorated with a party and celebrated by customers, suppliers and employees, culminating with a delivery ceremony to the customer, Byrnecut Australia.

After opening in 1971, the Turku plant immediately began manufacturing Sandvik TORO underground loaders. Over the years it

has been completely modernized, and today it is a state-of-the-art, 14,500-square-metre facility that produces a truck every other day.

"It is quite remarkable to consider the journey Sandvik in Turku has been on to reach this 9,000th machine milestone," says Lars Engström, president Sandvik Mining and Rock Technology. "This significant achievement is a statement of our production capability, market-leading performance and reliability of Sandvik equipment."



The Turku plant celebrates the rollout of its 9,000th unit in September.

THE QUOTE

“A project of this nature underscores Sandvik as a full-fledged solution provider.”

Donghong Zhang, senior deputy chief executive officer at NFC Africa Mining Plc, on the long-term agreement signed with Sandvik Mining and Rock Technology to help mine the Chambishi copper mine in Zambia.



Quarry Academy a smashing success

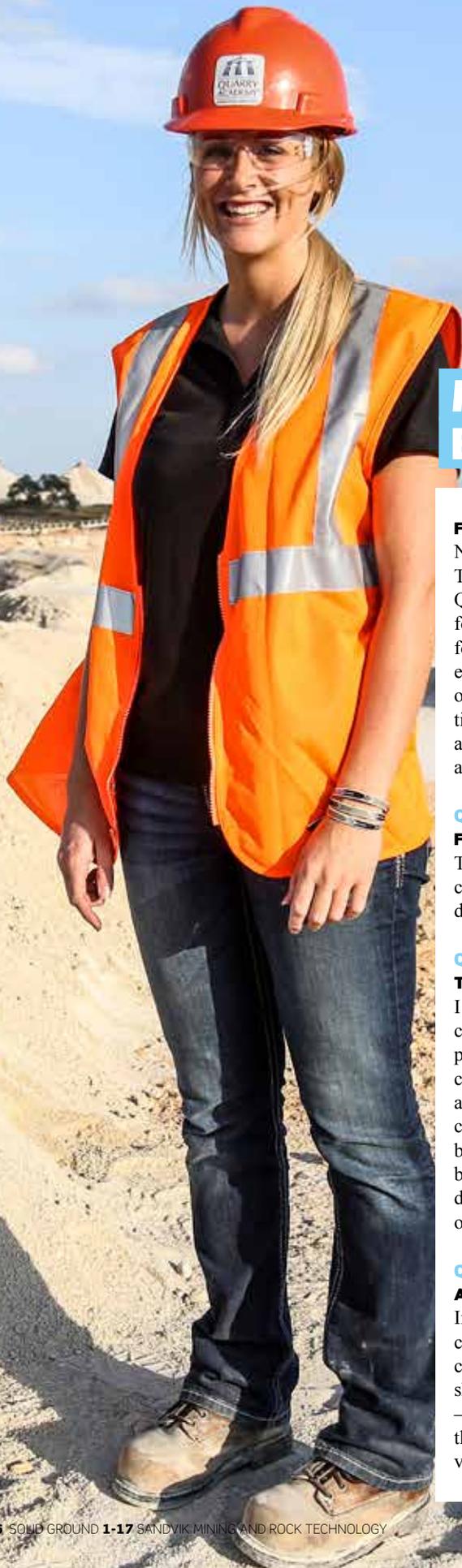
▶ Held over three days in November, the 11th annual Quarry Academy received rave reviews from attendees. The educational seminar, held in San Antonio, Texas, and hosted by Sandvik Mining and Rock Technology and Dyno Nobel, offered workshops focusing on best practices to improve process efficiency across a variety of disciplines in the aggregate production process including mineral extraction, drilling, blasting, crushing, sizing and processing. The seminar also provided workshops covering other aspects of quarry operation, such as planning, legal issues and safety considerations.

ABOUT THE QUARRY ACADEMY

Held every year, the Quarry Academy features industry experts in mineral extraction, drilling, blasting, crushing, sizing, processing and law, sharing knowledge and best practices with attendees. (See page 5 for more info.)

Q & A

MASTER BLASTER



FOR THREE DAYS in November, Dyno Nobel and Sandvik Mining and Rock Technology conducted the 11th annual Quarry Academy, an educational event focusing on improving process efficiency for producing aggregates in a safe environment. *Solid Ground* spoke with one attendee, Justine Sorensen, construction blasting and quarry drilling manager at The PEXCO Company, about her job and what she learned at the 2016 event.

Q WHAT IS THE PEXCO COMPANY'S FOCUS?

The PEXCO Company is an American contractor that focuses on construction drilling and blasting, and quarry drilling.

Q WHAT ARE YOUR KEY RESPONSIBILITIES AT WORK?

I manage our drillers and blasters. In construction, that pertains to obtaining permits, meeting with gas and electricity companies about where we're blasting, and managing the relationships with our contractors. But I also have some blasting duties, particularly when we get busy. On the quarry side, I manage the drills and coordinate our tasks while organizing the work flow for the team.

Q WHAT DO YOU FIND CHALLENGING AND ENJOYABLE ABOUT YOUR JOB?

In the construction business, the only constant is change. That's the biggest challenge: staying on top of a forever-shifting landscape. And I love blasting – who doesn't? All of it, the physics of it, the controlled explosions. It's always vital to adhere to safety standards, but I

must say that having all that power at your fingertips is thrilling.

Q WHAT ARE THE BIGGEST STRENGTHS OF YOUR SANDVIK DRILLS?

We have two Sandvik DX800 drill rigs and just bought a new one recently. Even though we only have a few, the durability and versatility of a DX800 is hard to beat.

Q WHAT DID YOU THINK ABOUT THE QUARRY ACADEMY?

Our company has a strong relationship with Buckley Powder Company, a joint venture with Dyno Nobel, and it was recommended to me by one of their reps as a great way to better understand the business. I'm quite impressed with the event overall. I really appreciated the examples and data put forth to make a point, particularly during the seminar on fuel consumption and how different options offer different savings. An event like this with a mix of experts, professionals, managers, foremen and labourers provides for a fantastic learning experience and a great networking opportunity. ■

JUSTINE SORENSEN

TITLE: Construction blasting and quarry drilling manager.

HOBBIES: Camping, hiking and walking her dog Bentley, a German Shepherd-Malamute-Husky mix.

FAMILY: Oldest of seven children (three brothers and three sisters).

2017: THE YEAR IN MINING

Multinational professional services firm Deloitte's annual report *Tracking the Trends 2017* discusses the top 10 trends that mining companies will face this year.

1

UNDERSTANDING THE DRIVERS OF SHAREHOLDER VALUE

Miners seek a balance between financial discipline and growth.

2

UNLOCKING PRODUCTIVITY IMPROVEMENT

Focus shifts to becoming serial innovators.

3

OPERATING IN AN ECOSYSTEM

Collaboration will drive the industry forward.

4

THE DIGITAL REVOLUTION

Mining starts to reinvent the future.

5

MAPPING THE THREAT LANDSCAPE

Cybersecurity concerns accelerate.

6

CREATING A SHARED VISION FOR THE SECTOR

Using compliance as a source of competitive advantage.

7

RE-EARNING THE SOCIAL LICENCE TO OPERATE

Environmental sustainability and energy management move into sharper focus.

8

SUPPORTING STRATEGIC PRIORITIES

Miners transform their operating models.

9

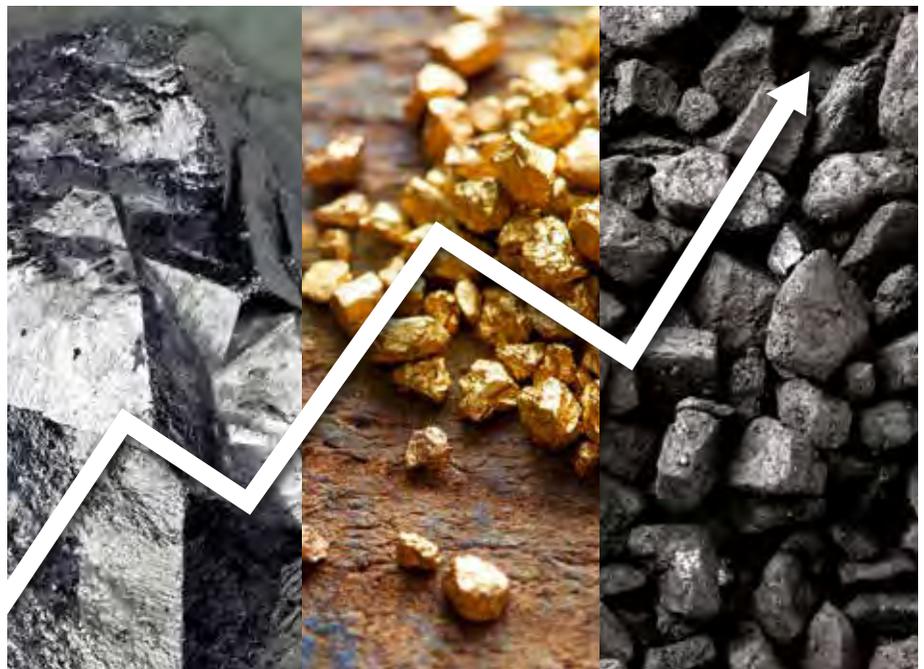
CREATING HEALTHY AND INCLUSIVE WORKFORCES

Prioritizing wellness and diversity.

10

ADOPTING AN INTEGRATED APPROACH

Demands for greater disclosure and transparency.



Commodity rally

▶ After a run of low commodity prices, 2016 showed what the mining sector hopes are the first signs of recovery. Prices increased across a broad range of commodities, boosted primarily by demand from China.

Coal was one of the best-performing commodities - the price of metallurgical coal, a key ingredient in steelmaking, peaked at more than USD 300 per tonne from just USD 80 per tonne at the start of the year. The price of iron ore rose to almost USD 80 per tonne in November, a 100 percent increase on the start of the year.

The surprise rally in commodity prices at the end of 2016 has reignited exploration activity and is expected to lead to an overall increase in production.

With higher prices, coal mines in Australia, Canada and Mozambique, mothballed when prices were below USD 100 in 2015, have been brought back into production. Two of the world's largest mining groups, BHP Billiton and Rio Tinto, have said they expect to see increases in both metallurgical coal and iron ore production volumes in 2017.

Miners going green?

▶ Miners around the world are turning to renewable energy to control energy costs. At the Energy and Mines World Congress in Toronto, Canada, gold miner Newmont Mining said its No. 1 opportunity was solar energy at its operations in Tanami, Australia, and in Peru. The company will also focus on micro-hydro power in Peru and hydrogenation-derived renewable diesel for its underground operation in Nevada.

"We'll have to make those changes gradually and in a way that is cost-effective to our operations," says Frank Roberto, Newmont's chief metallurgist, stating that dependence on traditional power sources has slowed the transition to alternatives.

Michel Carreau, Hatch Energy's director of energy, said the Paris Accord could help push miners towards sustainable energy to avoid a possible USD 50 per tonne carbon tax.

"Ten years from now there is not going to be a mining company that starts a project with a life of at least 10 years without putting in renewable power," he says.



DATA AND DIAMONDS - a marriage that lasts forever

▶ Diamonds can be used as a way to store vast amounts of data indefinitely using atom-sized flaws ordered in 3D arrays, according to the journal *Science Advances*. A team of physicists from City University of New York used lasers to encode and read data on diamonds' atomic-sized imperfections, called nitrogen vacancy centres.

These experiments suggest that diamonds could be used to encode data in the form of negatively and neutrally charged defects, which lasers can read, write, erase and rewrite, the publication said.



Three new uranium-rich materials found

▶ American scientist Travis Olds has found three new uranium-rich secondary minerals growing on the walls of a mine near the Red Canyon region of Utah. All three specimens - leesite, leőszilárdite and redcanyonite - "represent a small and unique slice of the earth's crust" where human activity spurred the formation of previously unknown materials.

"The only way to better understand the chemistry of uranium is to go out and find new minerals and describe their topology, their structures," Olds says. "They teach us a lot about how uranium can then be moved in the environment."

Is e-waste a potential gold mine?

▶ In light of the increasing popularity of energy-efficient light-emitting diode (LED) bulbs and lamps, researchers from the University of British Columbia in Canada say that recovering metals from LED lights may soon become an economical option. Professor Maria Holuszko says she and her team have successfully recovered copper and silver and are certain they may be able to extract some rare earth elements such as europium, cerium and lutetium without using chemicals.

The project piggybacks on earlier work done at the University of Edinburgh in which researchers developed a new extraction method that recovered gold from mobile phones, TVs and computers without using toxic chemicals, such as cyanide. The news takes on even more relevance considering the United Nations Environment Programme report called "Waste Crimes" which states that up to 50 million tonnes of electronic waste are expected to be disposed this year.

5,000,000,000

The value of the Northern Australian Infrastructure Facility fund, in AUD, that the Australian government could use for clean coal projects in the country. Clean coal refers to a collection of technologies that diminish the environmental impacts of coal-generated electricity, including carbon capture and sequestration.



Two-billion-year-old water discovered at Glencore mine

▶ Canadian scientists have discovered a prehistoric pool of water in the world's deepest base metal mine, Glencore's Kidd Mine in Timmins, Ontario. The water is estimated to be 2 billion years old and was found at about three kilometres down. According to University of Toronto geochemist Barbara Sherwood-Lollar, there's a significant amount.

"When people see this water they assume it must be some tiny amount of water trapped within the rock," Sherwood-Lollar says. "But in fact it's very much bubbling right up at you. These things are flowing at rates of litres per

minute - the volume of the water is much larger than anyone anticipated."

By analyzing dissolved gases in the ancient groundwater, researchers could date it back at least 2 billion years, but it's the sulphate content of the water that is raising even more interest. The sulphate in the water was produced in place, not brought underground by surface water, meaning these pools could potentially sustain microbial life - vastly expanding potentially habitable areas on the planet, given that billion-year-old rocks make up about half of Earth's continental crust.

The Expert

How Canada stays on top in mining



Maintain Canada's pool of uniquely skilled people

- Build a national database on labour market conditions and disseminate information to high schools and universities about skills that are in high demand, ensuring academic programmes are aligned with industry needs.
- Continue to fund initiatives for Aboriginal people and women to find careers in mining.



Become a world leader in developing mining technology and best practices

- Encourage and enhance the working relationship between industry and academia, and ensure work at public research facilities aligns with industry needs.
- Foster innovative alliances whereby patents and their technologies are shared.

Canada has been blessed with an abundance of mineral reserves, but the country is considered a world mining capital because it has developed smart policies tailored to establishing global prominence in the industry. Katrina Marsh, director of natural resources and environmental policy at the Canadian Chamber of Commerce, spoke to *Solid Ground* and suggested four key areas in which the Canadian government can act to maintain its competitive advantage in the industry. ■



Establish infrastructure internally and international agreements abroad to ensure a competitive future

- Invest in the infrastructure – roads, power plants – necessary to promote growth in the sector, unlocking the resource potential of the North.
- Pursue foreign investment protection agreements with foreign partners to help mitigate political risk to Canadian mining assets abroad.



Ensure community buy-in with an efficient and predictable regulatory environment

- Consult and, where necessary, accommodate Aboriginal peoples, establishing clear expectations for industry.
- Work closely with industry and other stakeholders to ensure intended regulatory outcomes are achieved.

Noble machines

■ Mining contractor BSHPU tripled its monthly development rate at the Artemyevsky mine in Kazakhstan, with some new equipment and a service agreement from Sandvik Mining and Rock Technology.

Text: MIKA VELIKOVSKIY Photo: ADAM LACH

Rich with ore, the Artemyevsky mine delivers 1.5 million tonnes yearly of zinc, copper and lead.



“**ONE NEEDS TO** be prepared for things like this in order to live here,” says Evgeny Reimer, Sandvik service manager for Kazakhstan, as he navigates his vehicle through a thick snowstorm. “It’s a rough place to live and work. Welcome to eastern Kazakhstan.”

Eastern Kazakhstan may seem unfriendly and ill-tempered this time of year, but it is not always like that. In contrast to many other regions of the country, its eastern part is neither arid nor deserted thanks to the gorgeous Altai Mountains, located at the intersection of Russia, China, Mongolia and Kazakhstan. The western face of those mountains is exceptionally rich with ore, and that is where the Artemyevsky polymetallic deposit is situated, in the geographic centre of Eurasia.

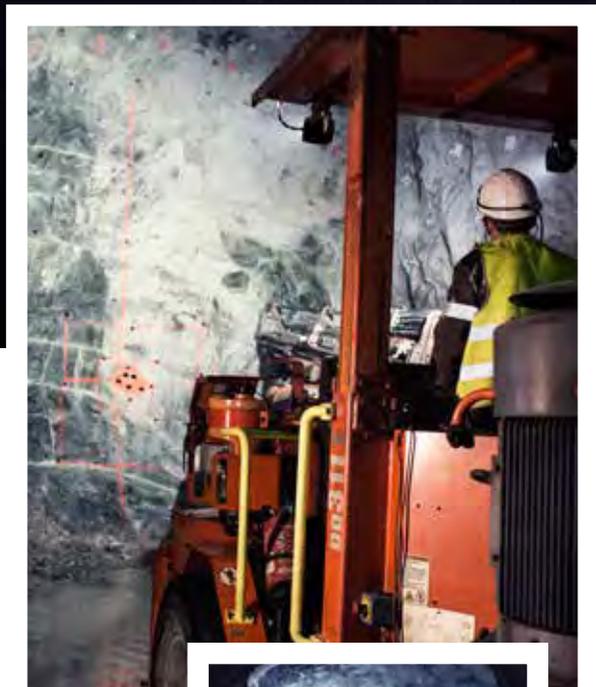
Discovered in 1958, its development started as an open pit, but over time it was transformed into a full-scale

underground mine with three vertical shafts and 13 horizontal levels. Every year it delivers up to 1.5 million tonnes of ore containing copper, zinc and lead.

THE IMPORTANT PROJECT that is currently under way is the construction of the second stage of the Artemyevsky mine, which will make it possible to extract ore from the deposit until 2032. It took the mine owner several years to thoroughly plan it and to get all the necessary clearances from the local regulatory bodies. By mid-2015 everything was ready, and a reliable contractor had to be selected. As a result of a public tender, the mine owner ultimately signed a contract with BSHPU-Kazakhstan, a subsidiary of the Russian company Bashkir Shaft-Sinking Management (BSHPU), a leader in underground mining construction in post-Soviet countries.

BSHPU is a producer itself, but its core profit is generated by development





Development pace skyrocketed from 100 to 300 linear metres per month after BSHPU started using the new Sandvik equipment.



and construction contracts for other mining corporations. Established in 1985, BSHPU has extensive underground experience with more than 20 projects in the company's portfolio, and it handles almost every imaginable task related to underground mining. Today BSHPU and its subsidiary company BSHPU-Kazakhstan LLP operate in three countries – Russia, Kazakhstan and Uzbekistan. In 2015 the companies of the group employed about 2,500 people in total. The aggregate turnover of the group exceeded USD 40 million.

The contract initially covered the development of several shafts, with overall extraction volume exceeding 65,000 cubic metres of rock during 2016.

“Such an ambitious project couldn't be realized without additional high-performance equipment,” says Evgeny Kolyada, head of projects of BSHPU-Kazakhstan. “And we knew we wanted Sandvik machines. They work at our sites both in Russia and

Kazakhstan, and believe me, no other manufacturer offers self-propelled mining equipment of comparable service life and reliability. Moreover, Sandvik offered us very comfortable financial conditions. Nothing was left to doubt.”

BSHPU PURCHASED A fleet of new Sandvik mobile equipment, including Sandvik DD311 and DD321 development drill rigs, two Sandvik LH410 loaders and three Sandvik TH320 underground trucks, all supplemented by a Toro 006 loader and an EJC 417 truck that the company already had at its disposal.

The underground equipment was commissioned in March 2016, and production quickly skyrocketed.

“The delivery of those new machines was a game changer,” says Alexander Salavatulin, chief mechanic of BSHPU-Kazakhstan. “The development pace rose from 100 to 300



Such an ambitious project couldn't be realized without additional high-performance equipment

ABOUT BSHPU

Bashkir Shaft-Sinking Management (BSHPU Plc) was established in 1985 as a company specializing in the construction of underground mines and above-ground mining structures. Initially it focused on projects in the Bashkortostan Republic of Russia - ore-rich foothills of Ural Mountains that separate Europe from Asia. Today BSHPU and its subsidiary company BSHPU-Kazakhstan LLP operate in three countries - Russia, Kazakhstan and Uzbekistan. In 2015 these compa-

nies employed a total of about 2,500 people. The aggregate turnover of the group exceeded USD 40 million.

BSHPU acts both as a contractor for the leading mining enterprises of CIS countries and as a producer itself. Its own polymetallic deposit operations in Russia and Kazakhstan add financial stability and strength to the organization. BSHPU's expertise covers sinking, raising, inclined and horizontal excavations.

These are noble machines - that's how I describe them

sides of the machine so that I or a colleague could immediately stop it in case something goes wrong. The cabin is not only comfortable but also feels safe. It has hydraulics in its pillars to adjust the height, and the roof withstands several tonnes of pressure.”

“These are noble machines – that’s how I describe them,” says Alexey Gorlach, the development foreman for BSHPU-Kazakhstan. “Our work is not always easy, but operating Sandvik equipment gives you a very important feeling, one of dignity.”

ANOTHER VALUABLE POINT in cooperation with Sandvik that is underlined by BSHPU colleagues is the product support and service the supplier offers.

Under the service agreement that BSHPU-Kazakhstan signed with Sandvik, a product support representative is present at the mine. His role is to oversee operations during shifts and to monitor the condition of equipment, making any necessary adjustments. As soon as maintenance is needed, he arranges the swift delivery of spare parts and consumables from one of three Sandvik warehouses in the region.

“Our main warehouse is located in the regional capital Oskemen, while two smaller ones are based near the

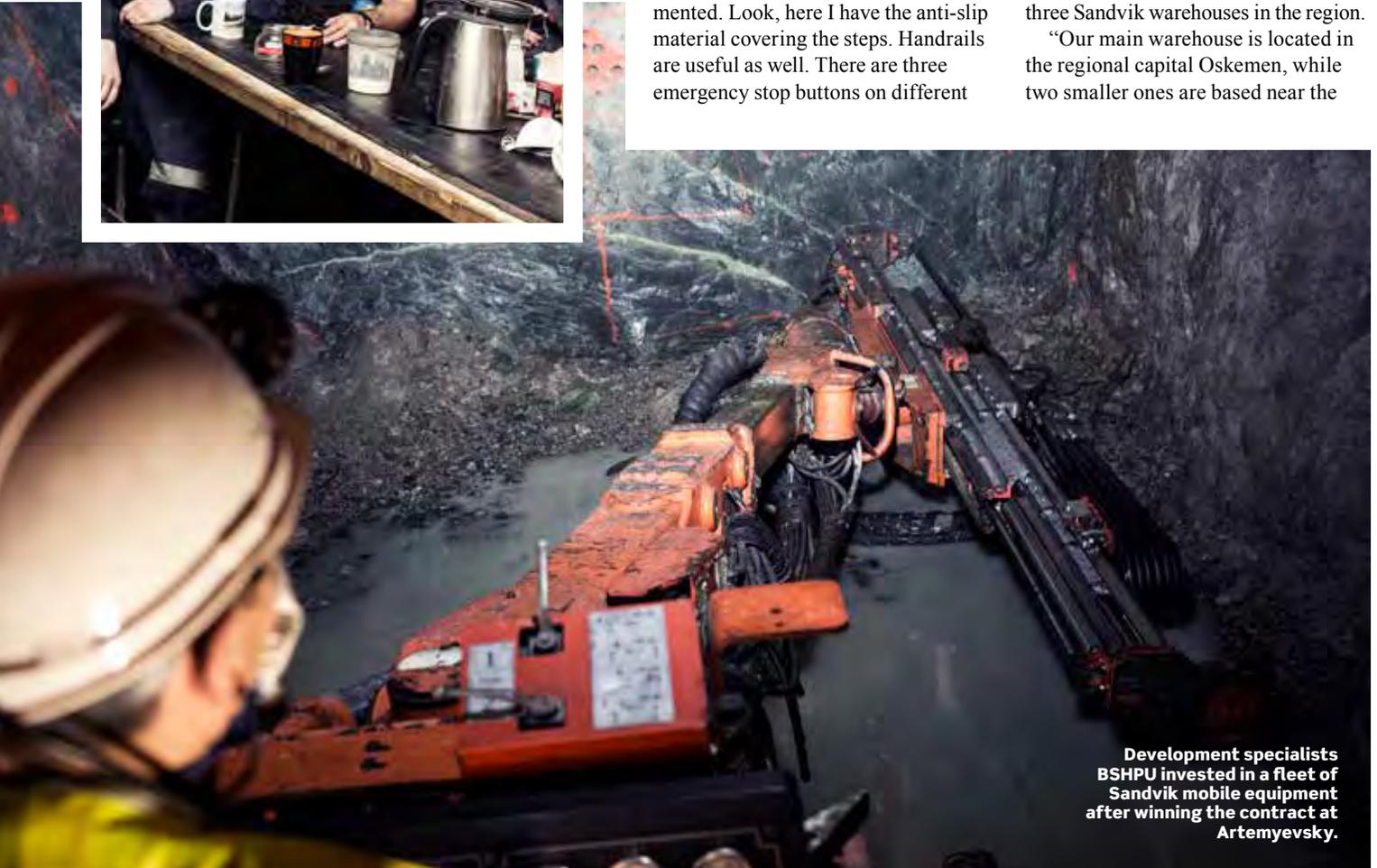
linear metres per month. Such a rate is a great achievement considering the complex geology of the Artemyevsky mine.”

A trip underground shows exactly what Salavatulin means. He points at the wall, reinforced with several layers of solid pine logs braced together with steel frames.

Situated 400 metres below sea level, Horizon 13 is currently the deepest horizontal shaft at Artemyevsky. Rapid development is under way, and BSHPU-Kazakhstan operators work diligently with their Sandvik equipment to meet production targets.

“I do like the new machine,” says Vitaly Pichurin, Sandvik DD311 drill rig operator. “It is agile and very powerful at the same time. And then there are all those safety features that are thought through and well-implemented. Look, here I have the anti-slip material covering the steps. Handrails are useful as well. There are three emergency stop buttons on different

The close-knit team of operators at the site appreciate the safety features of the Sandvik equipment.



Development specialists BSHPU invested in a fleet of Sandvik mobile equipment after winning the contract at Artemyevsky.

SANDVIK SOLUTION

BSHPU-Kazakhstan was contracted for horizontal excavations at the Artemyevsky mine, requiring the extraction of 65,000 cubic metres of rock during 2016 alone. The contractor invested in a new fleet of Sandvik equipment to fulfil the needs of the contract, including two development drill rigs (Sandvik DD311 and Sandvik DD321), two Sandvik LH410 loaders and three Sandvik TH320 underground trucks. In addition, BSHPU signed a service agreement with Sandvik Mining and Rock Technology to support the fleet.



repair facilities of our customers,” Reimer says. “It allows us to make consumables and most spare parts available at the time they are needed and to deliver the rest with minimal delay. It adds flexibility to our servicing system. We are there to help our clients whatever the circumstances may be.”

One of the supplementary warehouses is situated close to the repair shop of the Artemyevsky mine owner.

“It is very convenient indeed,” says Alexander Vinnichenko, the head of the repair shop. “We have several Sandvik machines at our disposal, and to have all the consumables at the ready is really handy. Otherwise we would be dependent on external factors, including the weather. And that can be rather harsh here.”

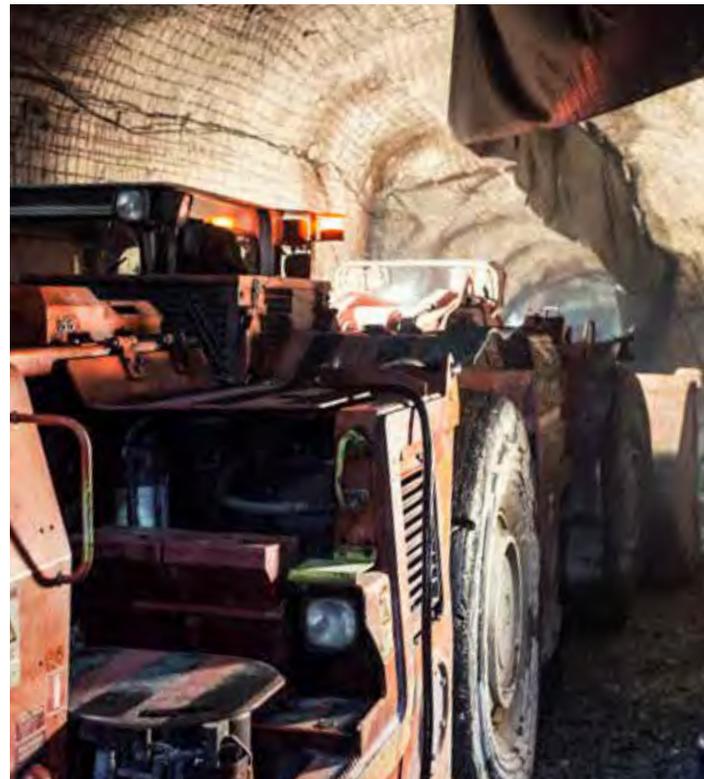
KOLYADA SAYS THE company is happy with the support and servicing system it has with Sandvik. “Thanks to it, the average uptime of our machines is 20 hours per day,” he says.

The impressive results achieved by BSHPU-Kazakhstan in 2016 earned the contractor a renewal for 2017. The construction of the second stage of Artemyevsky is planned until 2020.

“There is a lot more work to be done here, and we are eager to do it – with the help of Sandvik machines, of course,” Kolyada says. “We are now switching all our projects to Sandvik equipment, making it our only supplier. According to our calculations it is the most cost-efficient solution. It takes a lot of trust to commit to a single supplier, but we are confident Sandvik will support us.” ■



Average uptime for BSHPU's Sandvik equipment is around 20 hours per day, thanks to product support and service.



Text: TURKKA KULMALA Illustration: BÄSTA KOMPISAR

SECOND TO NONE

■ The new Sandvik CS550 cone crusher is a powerful secondary stage crusher for up to 700-tonne applications. In addition to flexibility and sheer tonnage, it offers advanced automation and maintenance features for maximal uptime.

The realities of today's economy force all crushing operators to take a hard look at their effectiveness and productivity. Can the process be more efficient without increasing the environmental footprint? Does it adequately meet the safety requirements set by EU's Machine Directive?

A key goal is to accomplish more work – essentially the sum of crusher capacity and reduction ratio – in each crushing stage while never losing sight of overall efficiency.

These ideas drove Sandvik Mining and Rock Technology to design Sandvik CS550, its latest next-generation cone crusher. Launched at the triennial CONEXPO-CON/AGG show in Las Vegas, the newcomer complements the first two 500-series crushers, Sandvik CH550 and Sandvik CH540.

Sandvik CS550 is a reliable, high-capacity and high-reduction workhorse for the secondary crushing stages. While nothing prevents Sandvik CS550 from being used in mining applications, its primary mission is stationary construction use. From a practical standpoint this means aggregate quarries, while contrac-

tors looking for mobile solutions may also benefit.

Sandvik CS550 achieves up to 25 percent higher reduction ratios compared to similar types of crushers. This enables the use of a larger jaw crusher in the primary stage and relieves the tertiary stage of some of its size reduction load, allowing a sharper quality focus. In some applications, Sandvik CS550 can already produce some finished material in the secondary stage.

Sandvik CS550 furthermore decreases the recirculating load by up to 50 percent with no decrease in the output of high-value product. In other words, less material goes back into the crusher to be reprocessed. This extends the service life of the wear parts, including particularly the costly manganese steel crushing chambers.

"Sandvik CS550 has a big intake to match the jaw crusher in the primary stage, with the possibility to produce large volumes, delivering a high reduction ratio and an excellent shape of the end product," says Martin Johansson, life cycle manager cones and gyratory crushers with Sandvik Mining and Rock Technology. ▶

Sandvik CS550 can produce finished material in the secondary stage.



TECH SPECS SANDVIK CS550

- **Total weight - crusher** 24,650 kg/54,350 lbs
- **Total weight - crusher on subframe** 30,670 kg/67,620 lbs
- **Height - foot to top feed hopper** 2,775 mm/109 in
- **Max. permitted power** 330 kW/443 hp
- **Capacity** 230-720 tph
- **CSS range** 27-70 mm/1 1/8 in - 2 3/4 in
- **Max. feed size** 345-431 mm/13 19/32 in - 16 31/32 in
- **Throw range** 24-48 mm/1 in - 1 7/8 in

We can make a huge impact on life-cycle costs, all backed up by real-world numbers

“The wide range when it comes to closed side settings, together with more and bigger throws, gives you extreme flexibility as Sandvik CS550 can be set to fit a huge variety of application needs.”

Owners of existing installations looking to upgrade their secondary crushing stage to match market growth now have an alluring option. The new cone crusher’s bigger intake capacity and adjustable eccentric throw enable higher capacity in the secondary stage. This allows opening up of the jaw crusher to process more material in the primary stage and to increase overall production.

The simple economics work in mines as well. These 24/7 operations are all about tonnage and extreme reliability with minimum downtime. More reduction in the secondary stage means more final product to bypass tertiary crushing. Less recirculation means less wear and less downtime.

A mine may not typically need additional crushing capacity, but a more powerful secondary crusher enables tertiary capacity reduction and provides finer feed for milling, resulting in substantial energy savings potential for the overall comminution process.

A major competitiveness factor for Sandvik CS550 in all applications is the complete elimination of plastic backing materials in the crushing chamber and substantial improvements in the maintenance ergonomics, including extensive commonalities with other Sandvik cone crushers.

Eliminating the plastics also eliminates curing times and shortens downtimes thanks to quicker liner changes. Fumes from toxic backing materials are avoided, exposure to hazardous handling and welding is reduced, and there is no need to dispose of plastic waste.

Other time savers include a new quick-release function for faster extraction of the concave from the top shell, enabling up to 90 percent faster liner change. The redesigned crushing chamber requires 65 percent less

lifting during regular liner changes compared to Sandvik CS440.

Sandvik crushers are engineered to maximize the company’s proven automation technology. The automatic setting system ASRi optimizes crusher operation for efficiency and adapts to variations in feed conditions by means of continuous liner wear measurement and compensation. The Hydrosset system provides automatic hydraulically powered mainshaft positioning and overload protection to permit the passage of uncrushables. The automation and control system offered as standard for Sandvik 500-series crushers ensures optimal capacity and reduction settings for the high-powered equipment.

Crusher operators’ top concerns – end-product quality, life-cycle costs, maximum productivity and uptime – call for well-rounded solutions where all crushing and screening stages as well as energy consumption and consumables are accounted for. Sandvik offers application knowledge, training capabilities and service that help meet these needs.

“The quarry managers’ decisions basically come down to balancing the capex and life-cycle costs,” Johansson says. “With our expertise, training and service offering, we can make a huge impact on life-cycle costs – all backed up by real-world numbers.” ■



ABOUT SANDVIK CS550

Key benefits in construction applications

- High intake capacity for increased productivity
- Bigger throw for more flexibility in varying needs
- Advanced automation for optimal capacity, reduction and process security

Key benefits in mining applications

- Higher reduction ratio enables substantial energy savings in downstream comminution stages
- Reduced recirculation for less wear and less downtime
- More uptime through easier, quicker, safer maintenance

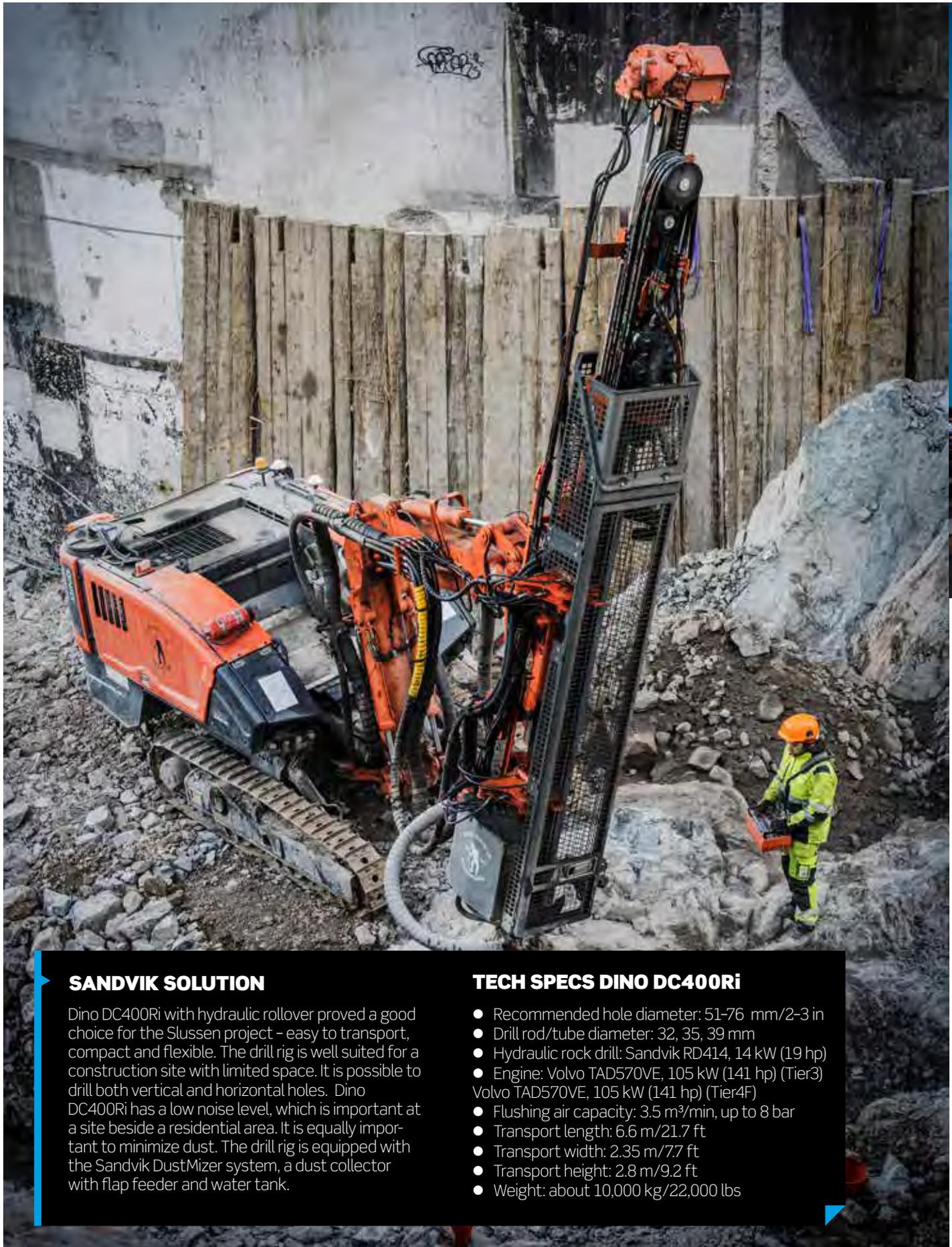


PLANNED PRECISION

■ Drilling and blasting in the cramped confines of central Stockholm requires a steady hand, perfect planning and agile equipment that can do its job accurately.

Text: SUSANNA LINDGREN Photo: SAMIR SOUDAH & RASMUS FORSGREN



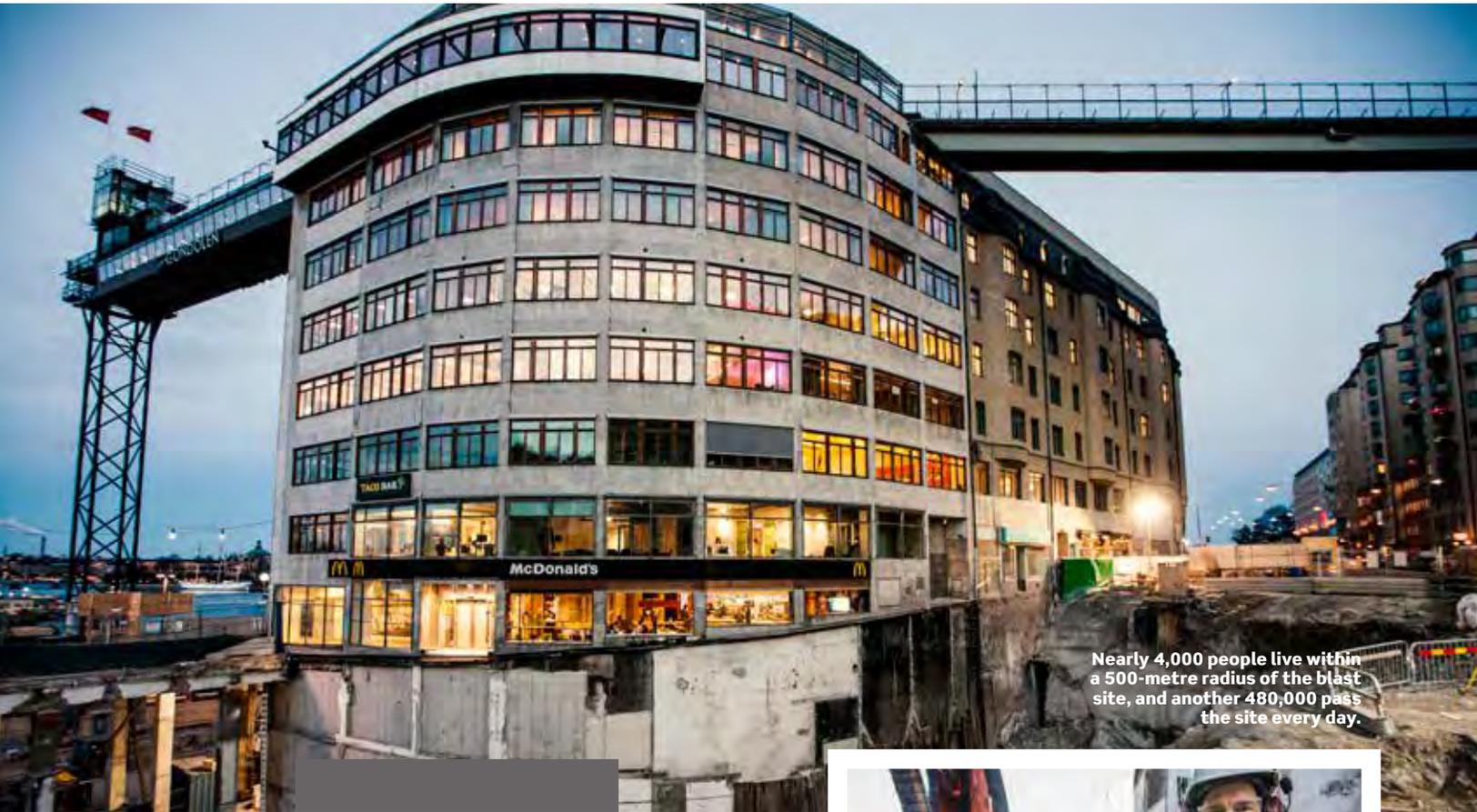


SANDVIK SOLUTION

Dino DC400Ri with hydraulic rollover proved a good choice for the Slussen project - easy to transport, compact and flexible. The drill rig is well suited for a construction site with limited space. It is possible to drill both vertical and horizontal holes. Dino DC400Ri has a low noise level, which is important at a site beside a residential area. It is equally important to minimize dust. The drill rig is equipped with the Sandvik DustMizer system, a dust collector with flap feeder and water tank.

TECH SPECS DINO DC400Ri

- Recommended hole diameter: 51-76 mm/2-3 in
- Drill rod/tube diameter: 32, 35, 39 mm
- Hydraulic rock drill: Sandvik RD414, 14 kW (19 hp)
- Engine: Volvo TAD570VE, 105 kW (141 hp) (Tier3)
Volvo TAD570VE, 105 kW (141 hp) (Tier4F)
- Flushing air capacity: 3.5 m³/min, up to 8 bar
- Transport length: 6.6 m/21.7 ft
- Transport width: 2.35 m/7.7 ft
- Transport height: 2.8 m/9.2 ft
- Weight: about 10,000 kg/22,000 lbs



Nearly 4,000 people live within a 500-metre radius of the blast site, and another 480,000 pass the site every day.

The blasting has started. Nine years of well-planned logistics to demolish the old and rebuild a completely new hub bridging the south city district Södermalm with medieval Old Town – while allowing an uninterrupted flow of 480,000 daily passersby – can begin in earnest. The wind is cold and biting this morning in February. At nine o'clock, a warning signal has just put the commuter flow of bikes and pedestrians to a halt. A muffled boom from underneath the blasting mats followed by a small vibration gives a hint of what's going on. Even so, very few of the people in the crowd are likely to give much thought to the precise calculations that just made it possible to blast away 50 kilograms of explosives in such a densely populated area. About 4,000 people live within a radius of 500 metres from the construction site. Eight hundred people work in the same area, and every day about 480,000 pass through the busy hub in this old sluice area, called Slussen, even if most of them go by bus or on the subway.

“The most challenging aspect of this job is actually the location,” says

Anders Hoffman, project manager at Skanska AB, one of the major construction contractors in this huge project that involves more than 25 different contracts. “The flow of transport must never be interrupted by the construction work, and that requires thorough planning. Right here we have to remove at least 10,000 cubic metres of rock. In another location this could have been done in one big blast. Here it will take a year.”

The Stockholm City vision is to replace the old and rundown traffic hub that was built in the 1930s with a new hub adjusted to accommodate the present traffic flow, making more way for cyclists as well as for public transport. The area will at the same time be transformed into a venue where new quays give access to the water to better utilize this meeting point between the Baltic Sea and the lake Mälaren. The scheduled completion date is in 2025.

HISTORY IS EVERYWHERE in this area. At the moment the site looks like nothing but a big hole in the ground. The curious passersby could probably spot what's left of the yellow floor tiles from the supermarket in the old underground



Mikael Kauppi, owner of Magnus Schakt, depends on the flexibility of his Dino DC400Ri.

shopping mall, and other traces of human activity were unearthed in another corner of the excavated area, namely several staircases dating from houses built in the 15th century. On land and in the water archaeological teams do their excavations to document as much as possible before it is all covered up again by a new dock area as well as new housing, shopping malls, roads and bridges. The latest discoveries were made in the water. Under a layer of modern remains, like shopping trolleys and rusty bicycles, various traces of business have been uncovered. In the 1600s and 1700s this waterfront area was a bustling trading area with mills, grinders and slaughterhouses.



Excavation at Slussen unearthed an ancient stairway and relics from a bygone era.

The most challenging aspect of this job is actually the location

The location has made Slussen an important hub and focus point for various interests and discussions for centuries. Long before traffic jams were invented this was a major transport route connecting the inland with the Baltic Sea. People have settled and traded in the area since the Middle Ages. In the 17th century 40 percent of all iron ore worldwide was shipped through this narrow passage. At that time elevation of the land made it gradually more difficult for ships to pass. This made the regent Queen Kristina build the very first sluice in 1642. In the early 1700s that lock proved too small and was

replaced in 1751. With steamships came the need for a third and even bigger lock in 1850. By now Slussen was not only a passageway for ships and boats. More and more people were using the lock to cross between the Old Town and the growing south city district of Södermalm. An increasing flow of carts and carriages in combination with the growing rail traffic made the movable bridge an obstacle. Several plans were made for a new and more modern passage. All of them were rejected, though. The arrival of the automobile in the 1920s finally got things moving. The constant bridge openings caused long queues, making the citizens of Stockholm cry out for a new solution that could put a stop to this “Slussen Misery.”

“Slussen has been rebuilt every century according to the needs of the time,” says Eva Rosman, communications manager for the Slussen Project at Stockholm City. “When building the fourth lock in 1931 there were new problems to solve, and I imagine that there were just as lively protests at that time as now. And most likely there were as many that embraced the

proposed new and modernistic style as there were people objecting.”

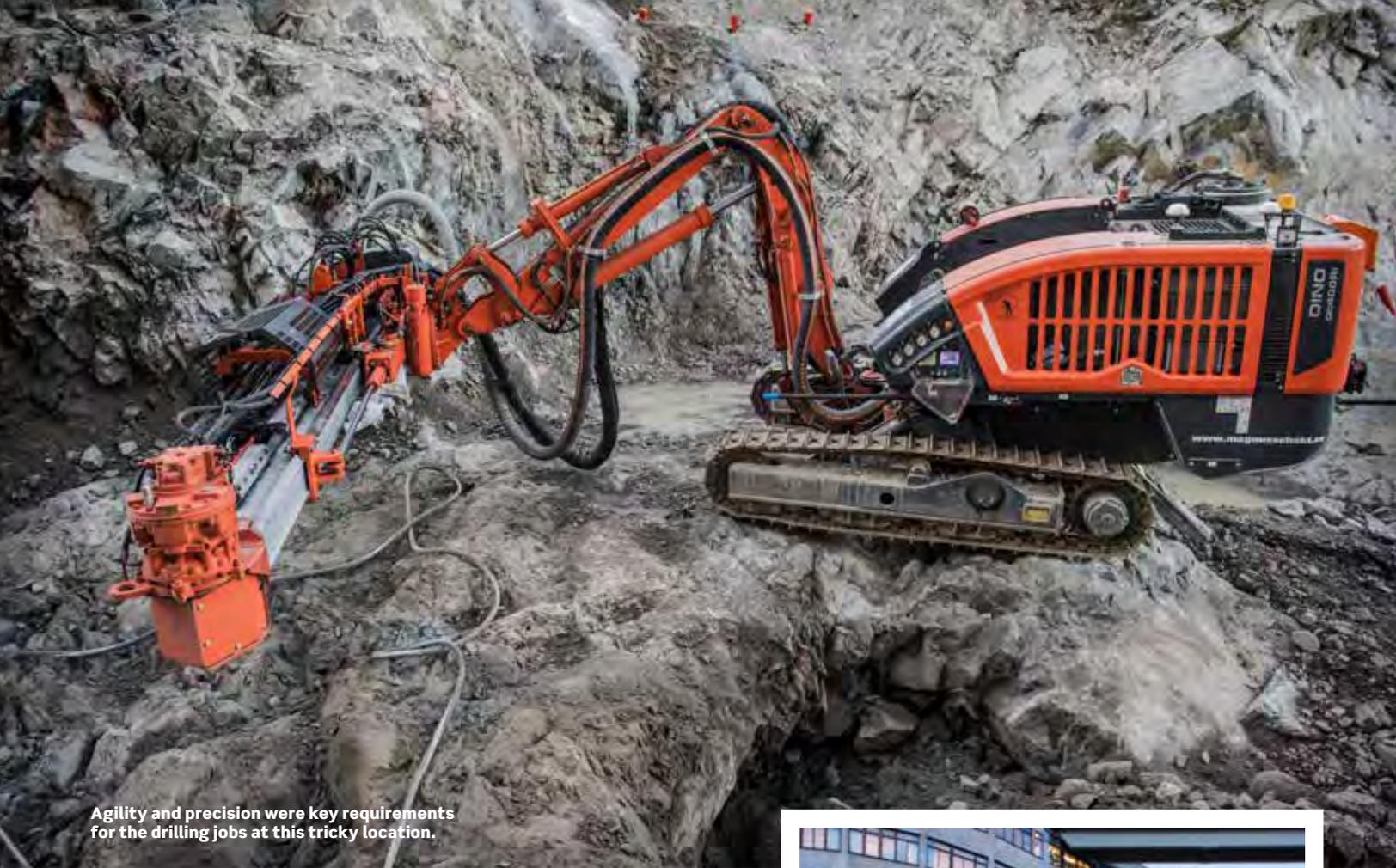
BLASTING IN THIS sensitive environment requires experience as well as the right equipment, and Skanska subcontracted the small but highly specialized drilling and blasting company Magnus Schakt AB to do the job.

“Price and experience in combination with the use of new machines that meet the environmental requirements, that’s why we awarded them the contract,” Hoffman says. “From day one they have been involved in the planning and have shared their expertise in blasting, which is a great advantage for us.”

Mikael Kauppi, the owner and operator of Magnus Schakt, is getting used to people watching his every move. The fencing surrounding the pit hole is itself surrounded by peep holes, but this adds no extra pressure for the seasoned blaster. He expertly manoeuvres his Dino DC400Ri top hammer drill rig with hydraulic rollover around the work area. Kauppi recognized that the challenging drill and blast environment required special equipment.

“This Dino DC400Ri was the first of its kind in Sweden when I got it a couple of years ago,” Kauppi says. “It’s very flexible, agile and dependable. It drills well, fast and with great precision. It’s perfect for a place like this.”

BEFORE BLASTING STARTED in January 2017, buildings in the area were surveyed and accelerometers placed on the most sensitive houses, many of which date from the 17th century. The blasting started on street level, and initially the Dino DC400Ri was working just outside a fast food restaurant. Ideally, all windows would have been boarded up as precaution, but that was not an option. The Dino DC400Ri has a low noise level and is equipped with the patented Sandvik DustMizer system. The DustMizer binds



Agility and precision were key requirements for the drilling jobs at this tricky location.

dust by spraying a mix of water and a natural agent into the rock drill, flushing air into the lower end of the dust collector. In the process the dust is transformed into a harmless damp and grainy soil.

As the work has moved further away from house facades and deeper down into the ground, the size of the blasts has become bigger. The biggest so far has involved 22 drill holes and 61 kilograms of explosives releasing about 100 cubic metres of rock. There will be about five more weeks of blasting to reach the first target of 13 metres into the ground. To get the logistics right, a new temporary bridge for bikes and pedestrians was required before the drilling and blasting could begin in the neighbouring mountain that will house part of the entrance to a new bus terminal.

“Every load of two to three kilos of explosives will go off 15 milliseconds apart,” Kauppi says. “The result will be a round of 50 to 70 kilos in one blast. That’s the maximum we can use to make sure there are no vibrations damaging the buildings around us.”

SANDVIK EQUIPMENT HAS for years been a natural part of Kauppi’s specialized business. The good cooperation

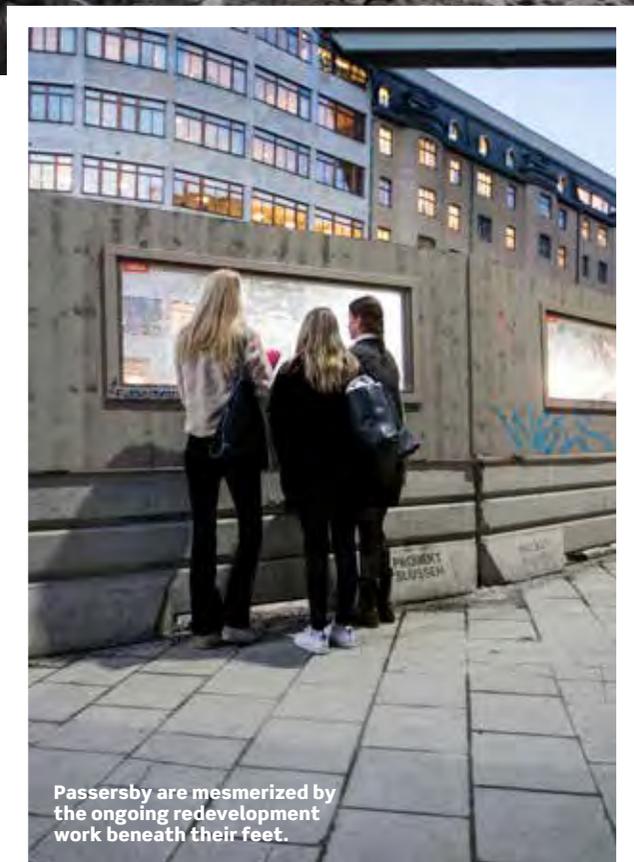
started when Mikael’s father Magnus Kauppi was running things. “Since dad bought his first Sandvik drill rig in 1981 it has only been orange machines,” Kauppi says.

That means that Sandvik Mining and Rock Technology sales engineer for surface drill rigs, Stefan Persson, has been working with two generations of Kauppis, both of whom have appreciated the advantages of using the same supplier. Kauppi and Persson speak regularly, at least once a week.

“Magnus Schakt is a great customer,” Persson says. “They are often looking for new and special solutions, like the Commando DC122R drill rig with standard diesel engine and powered with electricity to work in sensitive blasting missions for the Stockholm City Line project.”

The Dino DC400Ri working its way through the rock at Slussen is one of Magnus Schakt’s latest additions and the second of this model for Kauppi.

“I like to stay at the forefront and to try the latest equipment,” Kauppi says. “Besides the rollover option on this one, I particularly like the new dust foam function – the flap feeder DustMizer. That means we do not have to deal with dusty bags and messy vacuum cleaning sys-



Passersby are mesmerized by the ongoing redevelopment work beneath their feet.

tems. I also appreciate that the machine is easy to dismount and transport. Unlike this project, many of our assignments are short and transportation has to be fast and easy.” ■

SANDVIK DU412i

Text: TURKKA KULMALA Photo: SANDVIK

CONTROL IN THE HOLE



■ The new Sandvik DU412i drill rig brings highly flexible and automated in-the-hole drilling to underground mining.

SANDVIK DU412i EXTENDS the Sandvik Mining and Rock Technology offering of advanced drilling solutions to in-the-hole (ITH) longhole applications. The third member of the supplier's Next Generation family of drill rigs follows in the footsteps of Sandvik DD422i and Sandvik DT922i.

In-the-hole technology substantially expands the Sandvik portfolio of longhole drilling systems. While top-hammer drills produce smaller holes at a faster initial penetration rate and with lower energy consumption, ITH technology delivers better accuracy particularly in fractured rock. It can drill deeper holes well beyond 100 metres as well as larger drilling patterns – essentially more tonnes per drilled metre. Hole sizes optimally range for top-hammer drills between 51 and 127 millimetres (2 to 5 inches), while ITH applications generally start from around 100 millimetres (4 inches) and extend well beyond 203 millimetres (8 inches), reamed holes up to 445 millimetres (17.5 inches) and V30 holes to 762 millimetres (30 inches).

Natural applications for Sandvik DU412i specifically will include production drilling fans, undercut drilling, slot raising, drainage and service holes, preconditioning holes,

reverse circulation for grade control and precollaring for exploration.

Flexibility based largely on commonality in components with the rest of the 400i-class is a key Sandvik DU412i feature. All Sandvik Next Generation drill rigs share common base components and carriers. Operators and maintenance technicians will find the equipment easier to use and service thanks to common components and similar user interfaces. Commonality of the spare parts among the Next Generation drills serves to minimize the required inventories.

THE NEW MODULAR mast and carousel design makes it even simpler to service and also enables modification of the feed and carousel configurations at a later date, even in field conditions, to respond to changed production needs or mine conditions. Standard, heavy hoist and V30 feeds all use a single feed beam. All centralizer, carousel and feed strength options have standardized mounting and electro-hydraulic controls.

The completely new drill module, specifically optimized for instrumentation and automation possibilities, was designed jointly by the Sandvik production units in Winnipeg, Canada, and Tampere, Finland.

The flexibility philosophy even

100+
Depth in drillable metres for Sandvik DU412i.

extends to the drill's power pack: the multi-voltage-compliant system enables mining contractors to freely move the drill rig from one country to another, as the machine can easily adapt to different network ratings ranging from 380V to 1000V in both the 50 Hz and 60 Hz frequencies.

Extensive automation is another key theme in Sandvik DU412i. The offering is structured on two levels: Silver-level single-hole automation as a standard for all rigs and Platinum-level automation for multiple-hole applications.

The single-hole automation system enables the drill to automatically drill a hole to depth and retrieve the drill string when completed, allowing the operator to temporarily leave the equipment during drilling. The Platinum version builds on the automation by enabling automatic boom positioning between holes, drill plan handling and data collection with wireless transfer through the mine network. These automatic features increase equipment utilization through shift changes, during the blast

TECH SPECS SANDVIK DU412i

- Drilling module: standard feed (70 kN), 19 + 1 rod carousel (options up to 33 +1)
- Hole size: 89-762 mm (3 ½-30 in)
- Multi-voltage power pack: 380-1000 V, 50/60 Hz
- Engine: Cummins QSB4.5 diesel, 122 Kw, Tier 4F
- Onboard booster: 19 m³/min, 28 bar (400 psi), electronic control (up to 33 m³/min)
- Canopy: compliant with FOPS safety requirements (ISO 3449)
- Tramming length: 10,495 mm (413.2 in)
- Tramming T-section: 3,800 mm (149.6 in)
- Drilling height: 3,560 mm (140.2 in)

The new modular mast and carousel design makes it easier to respond to changed production needs or mine conditions.



clearing time or at any unmanned time of the day.

“Automation is a trend we see as very important,” says Jordan Letkeman, product manager for underground ITH production drilling at Sandvik Mining and Rock Technology, “not only in high-technology mines where it is used to increase utilization of a highly effective fleet into hours where the machine wasn’t previously operating, but also in lower technology areas where drilling automation can significantly raise the productivity of a new operator to be a much more consistent driller.”

The graphical user interface (GUI) of the drill control system visualizes what the unit is doing at any given point in time. All the relevant performance and status data, such as the positioning and angle of the drilling module, component



Jordan Letkeman, product manager for underground ITH production drilling at Sandvik Mining and Rock Technology.



status data and performance parameters, are shown in a clear and uncluttered screen layout. At the Platinum level, the GUI additionally visualizes the hole and fan proceeding data. The same GUI is used in all Sandvik Next Generation drill rigs for effective cross training possibilities and faster results with trainee operators.

The Sandvik DU412i control system enables radio remote operation for tramming, outrigger and levelling operations, drill module setup and carousel rod loading. The operator can now tram and set up the unit without having to sit in the cabin. Instead, the equipment can be set up from the area with the best visibility around the drill. On an even higher level, using teleremote drilling, a single command

centre can simultaneously run multiple units and integrate the drilling operations with loading and hauling operations by means of the Sandvik AutoMine system.

Drill plan handling and drill diagnostics based on the International Rock Excavation Data Exchange Standard (IREDES) file format provides compatibility with third-party mine planning systems and consistent daily reporting for improved and faster information available to engineering and operations departments. Readiness for the Sandvik OptiMine remote monitoring system and Sandvik AutoMine drilling fleet and information management system offers further possibilities in terms of digitalized mine infrastructure. ■

VALUE ADDED

- Safer for the operators: remote control tramming
- Next-generation underground mining innovation: extensive automation options, compatibility with teleremote control, future-proof for upgrades
- Flexibility in changing conditions: modular applications modules, carrier front and rear ends, multi-voltage power pack
- Efficient maintenance and lower costs: fully modular feed system, carousel and centralizers, spare part commonality, ground-level access



The control system for Sandvik DU412i enables remote operation for tramming, outrigger and levelling operations.

FUTURE TECH TODAY

Text: **JEAN-PAUL SMALL** Illustrations: **RITHUSET | STHLM**

■ **Technology, the scientific** embodiment of change. It is always evolving and progressing, with one invention invariably leading to the discovery of another. For OEMs, harnessing the power of tech to make safe, productive and efficient products is the key to staying competitive. Sandvik Mining and Rock Technology's tech insider is Patrick Murphy. In his role as

president of Rock Drills and Technologies, he focuses on trends and incorporates these new concepts into product designs to increase their productivity, reduce total cost of ownership and improve safety and reliability. He shares his thoughts on the status of modern tech, how Sandvik uses it in its products and how these technologies will transform the way we work in the future.

INTERNET OF THINGS

Definition: *The interconnection, via the internet, of computing devices in objects enabling them to send and receive data.*

Industry example: Aircraft engines

Sandvik example: Data driven productivity (DDP)

- Hardware and software that collect and process large amounts of data from onboard equipment during the work process and the surrounding environment to provide customers with real-time actionable insights to improve their operations.
- Four pillars of DDP:
 - Predictive maintenance - providing maintenance to equipment before it's required to ensure maximum uptime.
 - Production management - maximizing productivity by removing inefficiencies in operation.
 - Individual machine performance - measuring overall equipment effectiveness to maximize process efficiency.
 - Operator efficiency - collecting data on operator performance to determine where product redesign or additional training may help improve safety or asset utilization.



Patrick says: "We have the ability to measure more on our equipment than ever before. When we combine the onboard data with other data sets available from our customer processes, we can get amazing insights to help our customers immediately improve their operations."



AUTONOMOUS VEHICLES

Definition: A vehicle that is capable of sensing its environment and navigating without human input.

Industry example: Self-driving cars

Sandvik example: AutoMine

- Launched the first automation system for loading and hauling applications in 2004.
- Each vehicle knows where the others are using the traffic management system.
- Leverages the Sandvik navigation technology and algorithm.

Patrick says: “Our installed base consists of more than 150 vehicles in the world and represents over 1.5 million hours of autonomous operation to date, with zero lost time injuries. Automation improves safety and utilization of equipment while lowering operating costs.”



3D SCANNING

Definition:

Capturing real-world data to create a point cloud and convert it into a 3D model.

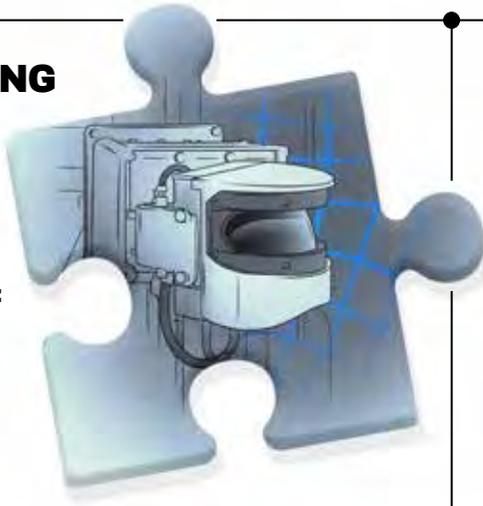
Industry example:

Measuring the volume of timber in a forest

Sandvik example:

- Integration of scanning technology into underground development drill rigs
- Mounted on underground equipment, a 3D point cloud of the mining environment is created and can be used in a variety of ways, including:
 - Navigating the drill rig so it knows where it is in the mine plan.
 - Determining the volume of material excavated in the tunnel.
 - Calculating against the mine plan whether there was overbreak or underbreak relative to the drift profile.

Patrick says: “This tech can measure where you are in the mine, volume in cubic metres of the material excavated and determine whether you’re on plan or not. All the data is stored onboard and, depending on the mine’s infrastructure, can be transmitted back to the control room or planner’s office via WiFi or storage media.”



Patrick says: “This equipment features patented charging-while-drilling technology that was born out of our research and development programmes, and regulates the charging process as the rig is working and connected to the mine electricity grid. With this technology, battery range and service life are enhanced.”

GREEN POWER SYSTEMS

Definition: Electrical energy storage and transmission that limits pollution, providing the highest environmental benefit.

Industry example: Battery electric vehicles

Sandvik example: Sandvik DD422iE and Sandvik LH307B battery-trammed underground equipment

- Both the Sandvik DD422iE battery-trammed mining jumbo and Sandvik LH307B loader were designed to remove diesel particulate matter (DPM) from underground environments, mitigating health risks caused by DPM.
- They use either electricity from the grid or fully flexible battery solutions.
- With Sandvik DD422iE, downhill tramping does not consume power but tops up the batteries.
- Sandvik LH307B eliminates all exhaust emissions with all the independence and power of its diesel counterparts.



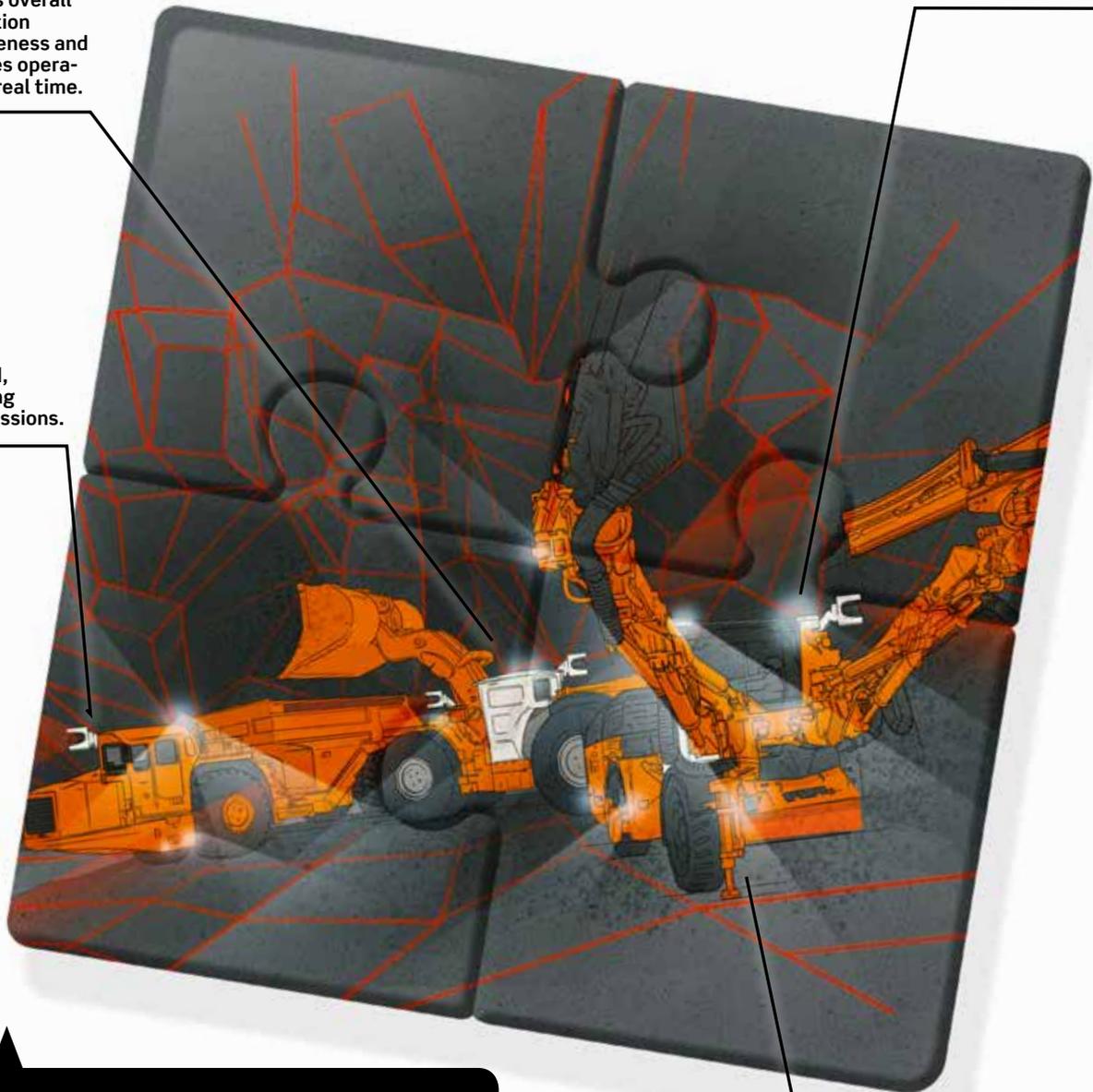
Piecing it all together

■ Here's one vision of underground mining equipment's future.

Sandvik DDP analyzes overall automation effectiveness and optimizes operations in real time.

Battery powered, producing zero emissions.

Onboard 3D LiDAR scanners with fast processing ability sweep the environment and enable real-time decisions based on current and predicted events.



Patrick says: "There is no science fiction about it. Our mission is to offer our customers optimal solutions designed to increase their productivity, reduce total costs of ownership and ensure reliability, efficiency and safety through high technology."

Fully autonomous vehicles that operate without restrictions, teach themselves and redefine how orebodies are mined.

PROTECTIVE PRODUCTIVITY

■ The tough Sandvik HX900 material has helped a copper mine in Arctic Sweden improve environment, health and safety (EHS) conditions while increasing productivity.

Text: DAVID NIKEL Photo: PRIME SOLUTIONS

Sandvik partnered with engineering consultancy firm Prime Solutions to develop a modular solution that improved the quality and efficiency of maintenance procedures at a copper mine in northern Sweden.

The conveyors that helped to transport millions of tonnes of crushed rock to the surface of the copper mine were subjected to heavy impact and abrasive wear, posing safety and productivity concerns. Frequent maintenance sessions were required, interrupting production and creating safety risks for employees.

Combining Sandvik HX900 wear protection and materials knowledge with Prime Solutions' system engineering into a new chute design gave the mine owners increased productivity and improved working environment safety for the mine owners.

Situated in the heart of Swedish Lapland, the copper mine is so far north

that temperatures of below -20C are commonplace. Despite such harsh conditions, more than 100,000 tonnes of chalcopyrite and pyrite are mined and transported around the clock every day at the open-pit mine, which yields vast quantities of copper alongside some silver and gold.

With large mining equipment operating around the clock in an environment that experiences extreme cold and total darkness in December and January every year, the mine's top priority is the safety of its 600-plus employees.

ONE RECENT EXAMPLE involved the chutes used to transport vast quantities of rock for further processing. The impact of the rough crushed rock caused the chute liners to become damaged on a regular basis and therefore require regular inspections.

The risk of injury from falling rock during the maintenance sessions was



Oskar Larsson,
product manager
wear protection at
Sandvik Mining
and Rock
Technology.

high, while noise levels sometimes exceeding 100dB and dusty environment also caused problems. In addition to the EHS concerns, each inspection required production to be stopped for an eight-hour period every two weeks or so.

"Before our installation, maintenance workers needed to stop production and go into the chute itself," explains Oskar Larsson, product manager wear protection at Sandvik Mining and Rock Technology. "All the maintenance work took place inside the chute, with poor lighting and the risk of falling objects.

330

Production hours
lost before
implementing the
Sandvik HX900
solution.



In field tests, Sandvik HX900 wear plates withstood 250,000 tonnes of material before requiring replacement, compared to around 60,000 tonnes for other materials.



The increase in productivity is worth around 300 million Swedish kronor

The chute was not designed for such maintenance, so it was dark, dusty and hazardous work.

“Although they didn’t have to change all the liners every week, they had to inspect them and replace any that were showing signs of wear,” Larsson says. “All the mined material goes through the same chute, so all three crushers had to be closed down for every maintenance session, bringing production to a complete standstill. Over the course of a year, around 330 hours of production were lost.”

Prime Solutions is a specialized engineering consultancy based in Sundsvall, in central Sweden. It has

worked with the mine on projects including rock crushing hammers and the cable drums of the electric excavators, and was charged with finding a solution for wear protection of the chutes.

To improve wear times within the chutes, the firm used Sandvik HX900 composite, a unique material that combines the wear resistance of cemented carbide with the shock resistance, ductility and forming capability of nodular iron. The resulting hard material is ideal for high-impact situations in harsh environments.

IN FIELD TESTS during development of the material, Sandvik HX900 wear plates could handle 250,000 tonnes of material before requiring replacement, compared with around 60,000 tonnes for hardfacing AW5 and AW6, and less than 50,000 for other materials such as rubber, ceramic rubber and chilled cast iron.

The same tests showed that not only is Sandvik HX900 the longest-lasting material, it’s also the most cost-effi-

cient, representing a 25 percent to 50 percent saving on hardfacing AW5/ AW6 and being three to six times cheaper than other material solutions when the total cost of ownership is considered.

“SANDVIK HX900 IS A one-of-a-kind wear protection material that we have developed inside Sandvik for the past 30 years,” Larsson says. “We proposed it, but the challenge was to come up with the right castings for the chute.”

But finding the right material was only one part of the solution. Although Sandvik HX900 would extend the life of the chute liners, the risks for maintenance engineers had to be addressed.

Sandvik and Prime Solutions came together to develop a modular design for the new chute. This meant the chute itself could be removed and replaced with a spare, allowing maintenance to take place elsewhere. This means less disruption to production and less risk of a rushed maintenance session.

The modular, two-chute solution eliminates time pressure, allowing engineers to completely focus on the task.

“We spent a lot of time documenting procedures for maintenance routines and spare parts to improve the process for the maintenance engineers,” says Håkan Zaar, CEO of Prime Solutions. “In addition, the improved design of the complete chute resulted in a noise reduction of around 20dB.”

THE MINE’S MANAGERS were delighted with the combined improvement to safety and productivity. Several major risks of injury have been minimized, and maintenance now takes place in a well-lit, well-equipped workshop.

Because maintenance shutdowns are now needed less often, they can be scheduled based on performance, not necessity. Due to the enhanced wear protection and design of the new chute, they can put 16 million tonnes of rock through the chute before it needs a substantial repair, which is about 20 weeks of operation.

“The savings on person-hours alone is more than 1 million Swedish kronor,” explains Zaar, “although the biggest saving was the increase in production efficiency. For every lost hour of production, the mine owners lost out on around 1 million Swedish kronor. The increase in productivity is worth around



Previous chutes required maintenance staff to shut down production and enter the chute for inspection, potentially putting themselves in harm's way.

Sandvik HX900 combines the wear resistance of cemented carbide with the shock resistance, ductility and forming capability of nodular iron.



300 million Swedish kronor. From the maintenance staff to the senior management, everyone involved was very happy with the results.”

PRIME SOLUTIONS' FAMILIARITY

with the low temperatures and tough rock of the region and specialist knowledge of engineering solutions within other industries was enough for it to reach out to Sandvik.

“Sandvik is a very well-known company here in Sweden, but even so, Sandvik HX900 material was not so well-known,” Zaar explains. “I’ve been interested in composites since working in the Swedish air force, so I was very interested in figuring out if there was a better material available than rough hardfacing metals. I contacted Sandvik, which introduced me to Sandvik HX900, and we’ve worked together ever since.

“I’ve worked a lot with handling systems in the paper and steel industries, so I have a lot of knowledge about material fatigue,” Zaar says. “Some of the solutions I’ve been working with were designed for steam locomotives from years ago, but they can be applied to heavy mining, whereas some modern systems don’t work so well. I immediately

saw the potential in Sandvik HX900.”

Zaar believes the benefits of such a modular system featuring Sandvik HX900 can be enjoyed by many more mines around the world.

“With the extended life of Sandvik HX900, inspections and maintenance can be pre-planned, something that was not possible at the mine before this solution. Few mines that I know of can be so proactive with maintenance routines. There are many other mines that would benefit from solutions of this kind.”

Both parties agree that bringing together Sandvik products and materials knowledge with Prime Solutions’ system engineering experience gave the mine owners a solution that no single company could provide.

“Safety is paramount in all mining operations, but in harsh environments we all have to go the extra mile to protect each other,” Larsson says. “Sandvik HX900 can drastically improve wear protection in crushing, fragmentation and grinding operations, leading to increased productivity. But by working in cooperation with others, as we did with Prime Solutions in Sweden, Sandvik products can have a real impact on safety, too.” ■

SANDVIK HX900: DURABLE IN THE TOUGHEST CONDITIONS

Sandvik HX900 is implemented in the mining and mineral handling industries, steel works, concrete plants and road maintenance. It is used in crushing, fragmentation and grinding operations, where it can easily replace conventional wear-resistant steels, castings and hard-facing on wear parts subjected to severe stresses. It is produced in the form of composite or clad. The casting method used in both cases provides a metallurgical bond between the cemented carbide granules or tiles in the wear zone and the nodular iron in the base metal. It is also possible to have a mixture of composite and clad.

APPLICATIONS INCLUDE:

- Sliding
- Crushing
- Milling
- Mixing
- Cutting
- Scraping
- Grinding

THE BIG PICTURE

Quarry workers in Wales catch a ride on a Blondin up from the floor of the pit.



INSPIRING HEIGHTS

How a tightrope walker changed the way quarries carried loads between perilous locations.

Text: **JEAN-PAUL SMALL** Photo: **ISTOCK PHOTO**

BEFORE MODERN-DAY quarries conceived of loaders to carry tonnes of crushed rock from place to place, there was the Blondin. This high-wire contraption was a type of aerial ropeway used in open-pit slate quarries in Wales to lift and transport wagonloads of rock, typically from one hard-to-reach area to another. It operated by suspending a cable over an open quarry and attaching a crane pulley, which could be run back and forth across the cable. The pulley would be run out to the rock pile, lowered so the rock could be loaded, and then lifted and run to where the rock needed to be dropped off.

The first recorded use of a Blondin in the quarry industry was at Penrhyn Quarry, where the invention was installed in 1913. Penrhyn was based around a large pit some 120 metres deep and worked in a series of terraces. Quarry operators at Penrhyn employed a variety of means to transport slate from the terraces to the processing mills. Since many of the terraces were connected via inclines, Blondins were developed to connect the more remote terraces directly to the mills.

But where did the name come from? Well, that would be from Charles “The Great” Blondin, a famous French tightrope walker from the 19th century, whose death-defying feats inspired the quarry industry to adopt its own

specific technique. Known for his grace and agility, Blondin owed much of his celebrity to crossing over Niagara Falls at the US-Canadian border on a tightrope 340 metres long and eight centimetres in diameter, suspended 50 metres above the water.

He first accomplished the feat in 1859, but he made many subsequent trips, sometimes blindfolded and at other times pushing a wheelbarrow. He once crossed on stilts and once with his manager on his back. On another occasion he even sat down midway across the tightrope suspended above the gorge, cooked an omelette and ate it. Perhaps surprisingly, Blondin died of diabetes at the age of 73 at his home in London, England. His legacy was so synonymous with tightrope walking that many performers after him used his name to describe their own acts. In fact, just before the presidential election of 1864, Abraham Lincoln compared himself to “Blondin on the tightrope, with all that was valuable to America in the wheelbarrow he was pushing before him.” ■



Partners in productivity

With operations in more than 130 countries, Sandvik Mining and Rock Technology offers a comprehensive range of products and services tailor-made for your specific challenges. Regardless of the application, challenge or need our team is here to help you anywhere, anytime.

Learn how you can save on parts and services with the new Sandvik 365 iPad app. Use the ROI calculator to see how you can boost your bottom line.



iOS

ENVIRONMENT, HEALTH AND SAFETY (EHS)

Stay safe. Our objective is to eliminate harm to people and the environment. EHS is a fundamental consideration in all Sandvik operations, especially product development. Our ambition is to provide the safest products on the market. From our emission-reducing Compressor Management System for surface drills to fire protection, our products are designed to minimize environmental impact and reduce health and safety risks in your operations.



GENUINE PARTS AND SERVICES

Prioritizing uptime. In an industry where an hour of downtime can cost thousands, Sandvik 365 parts and services can save you millions, with round-the-clock service, qualified engineers and genuine parts on demand. When you can predict your productivity, you predict profitability. We not only supply industry-leading mining and construction equipment, our comprehensive aftermarket offering includes service solutions to add even more value to your operation, and genuine parts to extend your equipment lifetime.



SURFACE DRILLING

Power and precision. Sandvik surface drilling equipment is renowned for durability, reliability and productivity. For decades, our surface top hammer, surface down-the-hole and dimensional stone drilling rigs have delivered low total cost of ownership in quarrying, opencast mining and construction applications. We specialize in engineering surface drilling equipment that marries power and precision while improving operator safety and productivity.



UNDERGROUND DRILLING

Know the drill. Sandvik underground drill rigs are engineered to maximize your productivity in mining and tunnelling applications. Equipped with high-performance hydraulic rock drills, they are ergonomic, efficient and reliable. Every underground drill rig and rock drill we engineer is designed to deliver you the lowest possible cost per metre drilled and a low life-cycle cost. Our drills range from robust, simple rigs to automated units that deliver extraordinary production rates.



CONTINUOUS MINING AND TUNNELLING

Always advancing.

Sandvik continuous mining and tunnelling equipment reflects the unique advantages of total in-house control over the equipment and cutting tools alike. Optimized cutting technology and machine design result in high productivity, long service life and low total costs.



LOADING AND HAULING

Reliable loaders and trucks.

Sandvik underground loaders and haul trucks are engineered for safety, productivity and reliability in the toughest of applications. Rugged, compact and highly manoeuvrable, the ergonomic products offer enormous capacity for their size and return a very low cost per tonne.



CRUSHING AND SCREENING

Maximum size reduction.

Sandvik crushing and screening solutions are engineered for productivity in mines, quarries and civil engineering projects. We offer advanced solutions for any size-reduction challenge, stationary or mobile. We can upgrade existing plants, deliver complete solutions and effect turnkey installations. We also supply individual crushers and screens, as well as key components and consumables. Whether you're crushing tonnes of hard rock or producing several sized aggregates with our mobile screens, our solutions deliver the robustness and versatility you need.



BREAKING

Hit harder.

Sandvik breakers and demolition tools make short work of difficult jobs. They are optimized to deliver high-impact cutting or crushing forces, with high power-to-weight ratios, easy interfaces and simple connections. Whether you're looking for breaker booms for your crushing applications or hydraulic breakers for your demolition projects, we have the precision tools and equipment you need to get the job done efficiently.



MINE AUTOMATION

Complete control.

The Sandvik AutoMine family covers all aspects of automation, from single equipment to full fleet control. In the safety and comfort of a control room, operators can simultaneously control and monitor the movements of a fleet of driverless loaders, trucks or drill rigs. By adding remote monitoring and process management capabilities, supervisors are able to directly communicate with equipment and operators from wherever they are working.



ROCK TOOLS AND SYSTEMS

Deep impact.

Sandvik offers the world's most comprehensive range of tools for exploration, rock drilling, raise boring, coal cutting, mineral mining, tunnelling, trenching, road grading and cold planing. As world leaders in steel and cemented carbide technology, our products have revolutionized the rock drilling industry, while our advanced tool systems for mining equipment raise productivity sharply.





NOT ALL HEROES WEAR CAPES

MEET YOUR NEW SUPER PRODUCER.

The new, high-precision Sandvik CS550 cone crusher is a true super producer. Offering up to 50 percent more capacity than other crushers in similar applications, 25 percent greater reduction ratio and 50 percent less recirculation with the same high-value product, this intelligent, uncompromising piece of power produces more — more throughput, more consistent product shape and more performance.*

* Test results and calculations are to be considered as results reached under certain and controlled conditions. These test results and calculations should not be treated as specifications and Sandvik does not guarantee, warrant or represent the outcome of test results or calculations in any or all circumstances.

