

SOLID

GROUND

#1 2020

A MAGAZINE FROM
SANDVIK MINING AND ROCK TECHNOLOGY

Canada:
**Blessing in
disguise**

800i series:
**Crushing
hard**

Sustainability:
**A brighter
way to break**

USA: Oconee County Quarry

Win the aggregate

SANDVIK

Dear reader,

WE HAVE SEEN tremendous activity and progress in the mining and construction industries in recent years. The demand to extract more tonnage in order to obtain metals and minerals and to produce more aggregates for construction, accompanied by ever-increasing expectations when it comes to safety, sustainability and efficiency, requires the industry to develop new, innovative technologies and methods.

AS PRESIDENT OF Sandvik Mining and Rock Technology, I am excited to play a part in leading that drive as we enter a new decade. As an organization, we focus on you as customers, working as a partner with you to develop and deliver products and solutions designed to help improve your safety, efficiency and productivity. Technology and innovation are at the center of our ongoing work to further strengthen our offering.

THESE ARE EXCITING times for our industry as it takes the next steps in its evolution, which revolve around automation, digitalization and electrification – an evolution in which Sandvik Mining and Rock Technology is committed to be at the forefront.

IN THIS ISSUE of Solid Ground, you will find great examples such as battery electric loaders, efficient crushing for production of aggregates, fully automated tunneling jumbos and much more.

I LOOK FORWARD to working with you going forward. As I often say, sustainability and productivity go hand in hand. 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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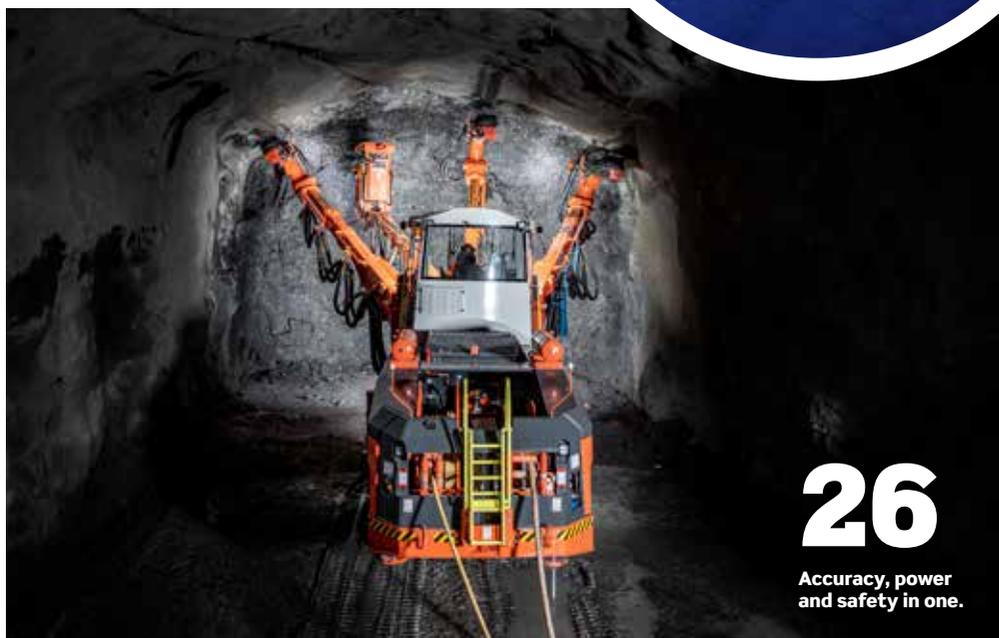
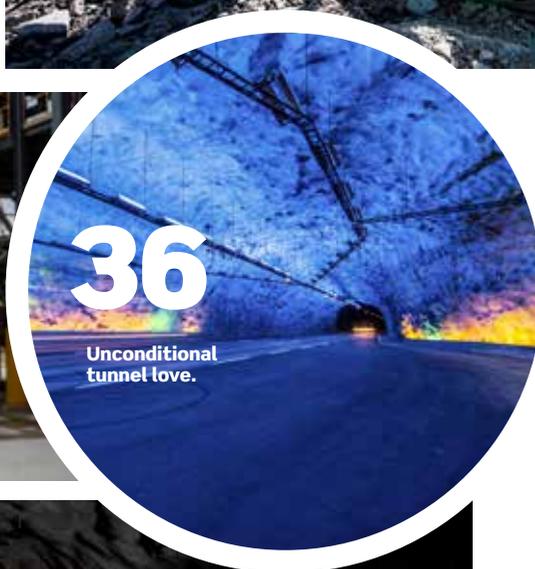
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Born — again — to crush

▶ When its aging crusher in Bunbury, Western Australia, began to fail in 2018, construction material supplier Hanson faced the prospect of a long and expensive plant closure to remedy the problem. Hanson then had several less than favorable options to choose from: they could shut the plant for a time-consuming crusher rebuild; they could completely replace the crushing plant with a new crusher; or they could wait for a new main shaft and hope a catastrophic failure did not occur. The local Sandvik team proposed another alternative – a Sandvik Reborn solution. By opting for a Sandvik CH440 Reborn, the operation was up, running and more efficient than ever in just two days.

“It was a painless process,” says Kyle North, who was site manager at the time. “We had a crane on-site and we pulled the old crusher out in the morning and had the new crusher in by the afternoon. Two days later we were up and running. It was certainly well coordinated by both sides.”



Safety first, safety always

▶ The new Sandvik LS312 heavy-duty flameproof underground loader is designed to meet the latest major international safety standards. Powered by a C7.1 mechanical engine with Tier II emission standards, the new 12-metric-ton loader includes electronic diesel engine safety shutdown systems and roll-over and falling objects (ROPS/FOPS) protection fitted as standard on all units. The engine has been developed into a new certified diesel engine system for Sandvik LS312 with targeted minimization of emissions, maintenance and total cost of ownership.

This new LHD utility vehicle with Sandvik quick detachment system (QDS) provides a safe and efficient solution to meet the challenges of underground coal loading and hauling applications and reduces personnel exposure to harmful diesel emissions through use of Tier II engine and integrated exhaust aftertreatment systems. Reduced consumables and up to 20 percent diesel fuel savings, as well as a 15 percent reduction in service time due to improved maintainability, contribute to lower operating costs.



Data-driven accuracy

▶ For New Zealand-based RedBull Powder Company, the quality of data gathered from each drill and blast is integral to driving safety, innovation and continuous improvement. Through its 10-year partnership with Sandvik, the integrated explosives services provider became the first New Zealand drilling and blasting company to use the GPS and measurement-while-drilling data capability that the TIM3D drill navigation system provides on new Sandvik drill rigs.

Four of RedBull's 12 Sandvik drill rigs have TIM3D drill navigation capability which improves drilling accuracy, efficiency and productivity in quarrying operations. Using satellite systems, the TIM3D's improved accuracy results in better fragmentation and fewer boulders and fines by producing parallel holes and keeping spacing and bottom levels accurate. The system also removes the need for surveying and hole marking, minimizing the risk of errors and speeding up drilling significantly.

“The machine control system allows automatic hole set-up and mast positioning,” says technical manager Nick Bastow, “increasing accuracy and reducing rework. And being able to send the drill plan directly to the operator electronically using GPS coordinates saves so much time.”



Battery powered and loading it

▶ Sandvik Mining and Rock Technology has delivered two Artisan A10 loaders to the Kirkland Gold Macassa mine in Ontario, Canada.

Artisan A10 is the most capable loader in its size class, with a carry capacity of 10 metric tons and outer dimensions equal to current seven-metric-ton diesel loaders. Packed with innovative design features, Artisan A10 delivers shorter cycle times through higher acceleration and faster ramp speeds, while utilizing regenerative

braking to capture energy to recharge the battery.

Artisan A10 uses the most powerful electric motors available and a patented Lithium-Iron Phosphate battery system, completely removing diesel particulate matter from underground environments. It is also equipped with a unique battery self-swapping system, speeding up time required for battery change, reducing infrastructure requirements and, most importantly, improving safety.

Drilling straight and narrow

▶ In keeping with the requirements of specialist mining companies as well as drill and blast contractors who need safer, productive mobile rigs for use in narrow-vein and other confined areas, Sandvik Mining and Rock Technology has launched a new family of narrow-vein drills. The Sandvik 2711 class of drills are simple and safer to operate with robust components and provide an excellent performance-to-ownership cost ratio.

Selective mining methods and small tunnel developments often enable more economic ore extraction, and control the dilution when ore is distributed in narrow veins typically less than six to 10 feet in width. The drills are equipped with Sandvik's fleet data monitoring systems, enabling mines and tunneling contractors to improve fleet performance and management. The series consists of three drill types using a common platform covering different applications: namely, development drilling with Sandvik DD2711, rock support bolting with Sandvik DS2711 and longhole production drilling with Sandvik DL2711 and Sandvik DL2721.



Performance and peace of mind

▶ With safety, efficiency and performance paramount, Sandvik Mining and Rock Technology has launched the new Sandvik DS512i bolter for 16-by-16-foot size headings. Equipped with a completely new carrier, high-frequency rock drill, control system and ergonomic cabin, Sandvik DS512i is safer and more efficient, providing peace of mind for rock reinforcement operations.

Intelligent control systems assist during drilling, grouting and bolt tightening, enabling a highly autonomous process. Machine efficiency is further maximized through easy-to-access service points from ground level, providing rapid maintenance and troubleshooting. As well as being the ideal bolter for tunneling, Sandvik DS512i comes complete with certain features that make it the ideal choice for mining bolting operations.

DINO MIGHT

▶ With two years of upgrades under its belt, the new remote-controlled Dino DC410Ri surface top hammer drill rig from Sandvik Mining and Rock Technology offers significant improvements in electrical and mechanical reliability, 15 percent higher tramping power and a large number of important updates for improved reliability and productivity.

A compact machine for 51 to 76 millimeter (2- to 3-inch) hole sizes, Dino DC410Ri is a major all-around upgrade from its predecessor Dino DC400Ri. It provides mobility and stability for contractors tackling cramped urban construction sites, as well as for demanding quarry and infrastructure applications. The Dino DC410Ri's entirely new electrical system responds to challenges with components such as I/O boards. Several mechanical details have been reinforced, including a steel-framed tramping support for the feed beam and ruggedized rod-handler arms.

Another practical feature is the possibility to duplicate the drilling control display on an Android phone or tablet. The remote screen gives a perfect view of the drill rig alignment and displays the drilling and tramping parameters for easy and accurate control.



At the heart of the process

BÜDINGEN, GERMANY. Basalt production has increased by 20 percent since Vogelsberger Basaltwerk modernized its processing plant by installing a new high-reduction secondary crusher.

TEXT: ERIC GOURLEY PHOTO: ADAM LACH

DIETER PRACHT LOOKS out over the Büdingen-Rinderbügen quarry, watching a shovel fill a haul truck. The operations manager for Vogelsberger Basaltwerk GmbH & Co. KG (VBW) must ensure processes and systems are optimized for the company to meet its target annual basalt production of between 500,000 and 700,000 metric tons.

Forty miles northeast of Frankfurt in southwestern Germany, VBW extracts basalt from a 19-million-year-old formation beneath the Vogelsberg mountain range, Central Europe's largest contiguous volcanic region.

VBW produces gravel, stone, sand and other raw materials primarily used as aggregate for asphalt and concrete. As demand for the company's basalt products has increased over the years, so have the strains on its all-important processing plant.

AFTER MORE THAN 30 years of secondary stage service, VBW's S1650 cone crusher had reached its capacity limits by 2016. Managing Director Bernd Krempel and Pracht researched a replacement with a higher reduction ratio, a crusher that would not only increase capacity but also improve product quality.

VBW initially intended to replace the outdated S1650 with a Sandvik CH-series cone crusher, which would have required a reduction in both feed size and overall



Bernd Krempel, managing director for Vogelsberger Basaltwerk.

throughput.

"Increasing production while maintaining the same target particle size would have been impossible," Krempel says.

Sandvik soon announced the launch of Sandvik CS550, and the new crusher's design immediately impressed Krempel and Pracht.

"It's basically a hybrid of assessed models, a flat cone crusher and gyratory crusher," Krempel says.

Capable of operating at higher pressures than other Sandvik CS-series crushers and featuring proven components from Sandvik CH-series models, Sandvik CS550 seemed to be the ideal solution for VBW.

Sandvik ran process simulations in September 2016 with its PlantDesigner software, using VBW's real-life figures for work index, basalt moisture, bulk density and clay percentage.

"That simulation process was very important for us," Krempel says. "The competence of our contacts at the company helped convince us."

DESPITE HAVING BEEN convinced of the new crusher's suitability for his operation, Krempel admits he still had nerves about being the first Sandvik CS550 user.

"We are talking about the heart of our facility, not to mention the corresponding investment costs," he says. "And because we were guinea pigs, we could only be offered good estimates on what the crusher might do for us. To that extent, I was nervous."

Pracht, on the other hand, was more confident.

"Personally, I wasn't nervous," he says. "I had a lot of trust. And I said to myself, 'If we're the first ones, Sandvik will take very good care of us and make sure it's a success.' And that's what happened."

VBW commissioned its Sandvik CS550



Dieter Pracht, operations manager for Vogelsberger, thinks that the high reduction ratio of Sandvik CS550 is its biggest advantage.



SANDVIK CS840i

Sandvik CS840i is a powerful, high-capacity secondary cone crusher that delivers precision and quality. Launched in September 2019 as the upgraded version of Sandvik CS550, Sandvik CS840i features the new Automation and Connectivity System (ACS) to ensure optimal operational and cost performance with minimal operator input. The new crusher is connected to My Sandvik and features an improved hopper. Sandvik CS840i can increase reduction ratio by up to 25 percent and reduce recirculation by up to 50 percent with the same high-value product.

VOGELSBERGER BASALTWERK

Vogelsberger Basaltwerk GmbH & Co. KG (VBW), part of the Dressler Verwaltungsgesellschaft mbH group of companies, processes basalt into a variety of rock products for civil engineering, road and asphalt construction and gardening and landscaping. VBW also produces natural and recycled blends and backfill material, and its basalt products are available in a wide range of sizes, grading and quantity. The company has 17 employees, 105 acres of clearing area and 175 acres of plant area.

in February 2017 and soon saw a notable increase in the plant's throughput capacity.

"The biggest advantage, and the one we hoped to have, is the high reduction ratio, and the smoother running of the process," Pracht says. "We can now achieve higher performance with the downstream pressure because we have less return flow. And in contrast to competitors' products, it has the largest possible intake."

Less recirculation resulted in reduced wear and less downtime.

"The costs fell, both with the actual crusher and with the downstream components like our gyratory crusher for producing double-broken chippings," Krempel says. "Because we're able to supply it with smaller pieces, the costs in wear and in electricity have significantly decreased."

SANDVIK CS550 FEATURES a redesigned crushing chamber to ensure improved product quality. VBW feeds 250 to 300 metric tons of 10- to 14-inch primary

crushed material per hour into the crusher's C-chamber intake. More than 80 percent is processed to VBW's preferred particle size of < 1.25 inches.

Pracht says Sandvik CS550's control system has major advantages over its retired predecessor. It only takes a few simple steps to adjust the crusher to different grain sizes.

"Compared to the old crusher, we now have much more flexibility," he says. "We can adjust our processes more quickly to meet the needs of our clients and to meet demand. We bought the CS550 in order to produce finer aggregates. But at the press of a button, we can adjust the cone, and we have coarser material immediately."

After more than two years of operation, the crusher's reliability remains as vital for VBW as its productivity.

"THE MOST IMPORTANT factor was the reliability, which we definitely need," he says. "Then the speed of the response when there are queries, or when there are actually

problems, is also key. Sandvik technicians are reliable. They're always willing to listen and they are always available for us. It's been a very pleasant working relationship and partnership."

WITH ITS SANDVIK CS550 at the center of a more productive processing plant, VBW has shifted its focus to exploring other potential optimization opportunities. Its primary crusher, for example, can barely keep the new Sandvik crusher 50 percent fed despite operating at its performance limits.

Despite the primary stage bottleneck, VBW has increased basalt production by 20 percent since installing Sandvik CS550, even operating the crusher at the smallest possible throw of one inch.

"It helps us produce a high-quality end product with a very consistent shape," Krempel says. "Sandvik CS550 has all the performance we require and then some." ■



ON YOUNG SHOULDERS

Adam Slusser loves his job. And why not? At 34, the aggregates plant manager of the CEMEX Balcones Quarry in Texas oversees the largest producing quarry in the US and has used a hands-on approach to learn all there is to know about aggregates.

Q: HOW DID YOU GET YOUR START AT CEMEX BALCONES QUARRY?

A: I actually went to school for actuarial science. I even took the first actuarial exam, passed that and did a couple of interviews for actuarial jobs, but I think that they could tell that I wasn't really into being an actuary. I graduated from Penn State and moved to Austin, Texas. After four years of landscape construction, I applied here to be a quality control supervisor at the quarry. They liked my statistical background for that role, and I was hired and started learning about aggregates. I got addicted to aggregates as often happens with people in this industry. Either you love it or you hate it. I love it.

Q: WHAT'S IT LIKE TO BE PLANT MANAGER AT SUCH A LARGE OPERATION?

A: This is the largest producing quarry in the United States for the past six years in a row. This quarry has a hundred-year life, and right

now sits on about 2,900 to 3,000 acres that comprises that hundred-year reserve life. Ultimately, as plant manager, you're the person that's responsible for everything. So, I'm out in the operation on a daily basis, looking at everything and helping the guys to be successful with what they do. I'm 34 years old and I'm a plant manager of the largest quarry in the United States. There's a great support team here. I help them out whenever possible, and in return they have my back.

Q: HOW HAS SANDVIK EQUIPMENT IMPROVED PRODUCTIVITY AT THE QUARRY?

A: We have two Sandvik CH660 cone crushers in our new wash plant, and we have the ASRi system on our cones and the electric dump valve system for uncrushables. We also have the offline filtration system that constantly filters the lube oil, ensuring that we almost never have to change the oil. I think we're at the top of what Sandvik offers

with these crushers, and they're performing well. Very well.

Q: WHAT IS THE MOST ENLIGHTENING ASPECT OF YOUR WORK HERE?

A: I've learned everything about aggregates on the job. I've gone to the Quarry Academy seminar and CEMEX has sent me to a lot of training sessions, internal and external. That's all been extremely helpful. But really, I've learned the most from being out in the operation and seeing how everything works. That's the best way to learn. ■

ADAM SLUSSER

Age: 34
Title: Aggregates Plant Manager
Hobbies: Religion, Pennsylvania State University sports, reading and research
Family: Married four years; two sons under age 3
Background: Raised in Hanover, Pennsylvania; high school valedictorian; Eagle Scout; first family member to graduate college.

The Expert

Master's student Ricardo Losa believes a circular model can bring economic and environmental benefits to Sandvik's Load and Haul division.



EARLY IN 2019, Sandvik Mining and Rock Technology began a collaboration with Lund University's International Institute for Industrial and Environmental Economics (IIIEE). The goal? To help its business become more sustainable. Master's student Ricardo Losa has since begun a research project to help the company's Load and Haul division adopt a circular model. He sat down with *Solid Ground* to discuss what he found and how implementing those changes can bring a myriad of benefits to the division and ultimately to customers.

Q: HOW DID YOU GET INVOLVED IN THE RESEARCH PROJECT TO BRING A CIRCULAR ECONOMY TO SANDVIK MINING AND ROCK TECHNOLOGY'S LOAD AND HAUL DIVISION?

A: Christina Hansson, senior global EHS specialist at Sandvik, is an alumna of IIIEE. She contacted one of our professors to gauge the interest of students at our institution to work

with Sandvik Mining and Rock Technology in general, and with its Load and Haul division in particular, on this goal. Sandvik understood that implementing a circular economy could bring definite economic, environmental, social and sustainability benefits. I began my research journey by attempting to understand the context in which Load and Haul operates, and I found that they were already doing a lot of circularity-related work.

Q: WHAT SUGGESTIONS DID YOU MAKE BASED ON YOUR RESEARCH ON THE DIVISION?

A: After assessing the methodology I used to see if it was effective in supporting the implementation of a circular economy, I provided some suggestions for improvement. Together with Sandvik, we prioritized these suggestions into three categories: working with suppliers, strengthening the rebuild program and focusing on product design.

Q: LET'S START WITH SUPPLIERS. HOW CAN THEY HELP THE DIVISION ATTAIN A MORE CIRCULAR ECONOMY?

A: One of the pillars of a circular economy is improving resource and energy efficiency. Suppliers can provide Sandvik with more sustainable materials to make equipment lighter or more fuel-efficient, or with materials that are themselves already recycled. Sandvik already has a target of being 90 percent circular by 2030, and it wants its suppliers to do the same, so this is a good place to start. Sandvik also plans to introduce a circular model throughout the company's supply chain.

Q: WHAT ABOUT THE REBUILD PROGRAM? HOW CAN THAT SUPPORT CIRCULARITY?

A: The rebuild program, in which older equipment is refurbished with new parts at a lower cost than completely new equipment, is the embodiment of a circular economy. It's a great source of competitive advantage, so it should be made as efficient as possible. One way is to standardize the rebuild kits to serve customers quicker, reducing downtime and increasing productivity. One small obstacle to that suggestion is that customers lose out on customization with standardization. This can be solved by targeting the parts that would most likely wear out and preparing them for substitution. The rest of the rebuild could be customized according to the customer's request.

It's also beneficial that parts and services experts are responsible for the rebuild program, as they can share vital information about what customers need in their rebuilds with the Load and Haul division, which can then include these upgrades in the latest iteration of the equipment.

Q: HOW CAN DESIGN IMPROVEMENTS AFFECT CIRCULARITY?

A: Several experts in the field of circular economy believe that design is the first and most important step to enable a circular economy. For the Load and Haul division, that means creating durable, long-lasting components out of recyclable material so they can be easily disassembled at the end of the life cycle. This should be done in such a way that all the valuable components can be separated in order to be recycled effectively. Also, the equipment should include as few material combinations as possible, so that separating components – plastic from metal, for instance – is not a problem when it comes time to recycle. ■



SURPRISE SAVIOR

PORT-DANIEL-GASCONS, QUEBEC. An unfortunate equipment breakdown proved to be a silver lining for the limestone quarry at Quebec's newest cement plant.

TEXT: **ERIC GOURLEY** PHOTO: **ADAM LACH**

FORESTS FLANK THE mountainside quarry adjacent to the McInnis Cement plant on northeastern Quebec's Gaspé Peninsula. The quarry provides panoramic views of picturesque Chaleur Bay, a popular fishing and tourism destination that separates Quebec from northeastern New Brunswick.

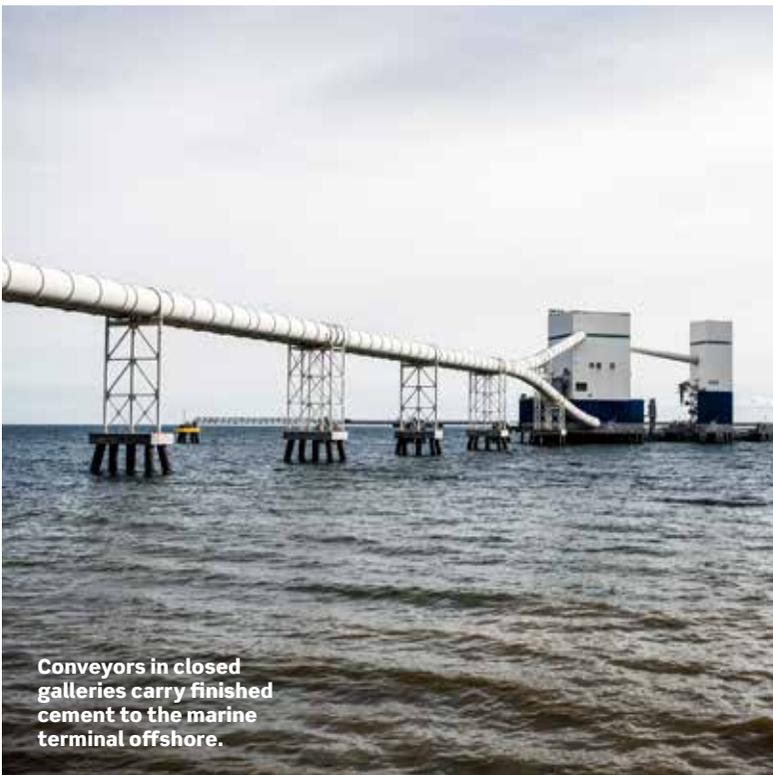
The location is as ideal as it is idyllic.

Limestone from the quarry feeds a modern plant that can produce 2.3 million metric tons of cement each year. Conveyors in closed galleries carry finished cement from silos to the deep-water marine terminal just offshore, where a fleet of ocean vessels with capacities up to 60,000 metric tons transport cement to distribution hubs along the Atlantic coast.

The greenfield industrial complex became the first new plant to serve eastern Canada and the northeastern United States in more than 50 years when it opened in 2017, and increased demand for its products has already driven McInnis to add storage silos at its Quebec plant and increase distribution infrastructure throughout the northeast.



This Leopard DI550 down-the-hole drill rig has helped McInnis stay productive in difficult conditions.



Conveyors in closed galleries carry finished cement to the marine terminal offshore.



"In 20 years that's the best top hammer I ever drilled with," says operator Renaud Langlois of Ranger DX900i.

RANGER DX900i

Ranger DX900i features the most powerful rock drill in its class, Sandvik intelligence features and a counter-weighted, revolving superstructure to improve stability. With an ultimate drilling coverage area of 290 degrees, Ranger DX900i saves time and minimizes repositioning needs. Its new compressor control system, innovative cooler layout and optimized pressure management system help to reduce fuel consumption.

That increased demand keeps the pressure on quarry director François LeMoal and his colleagues.

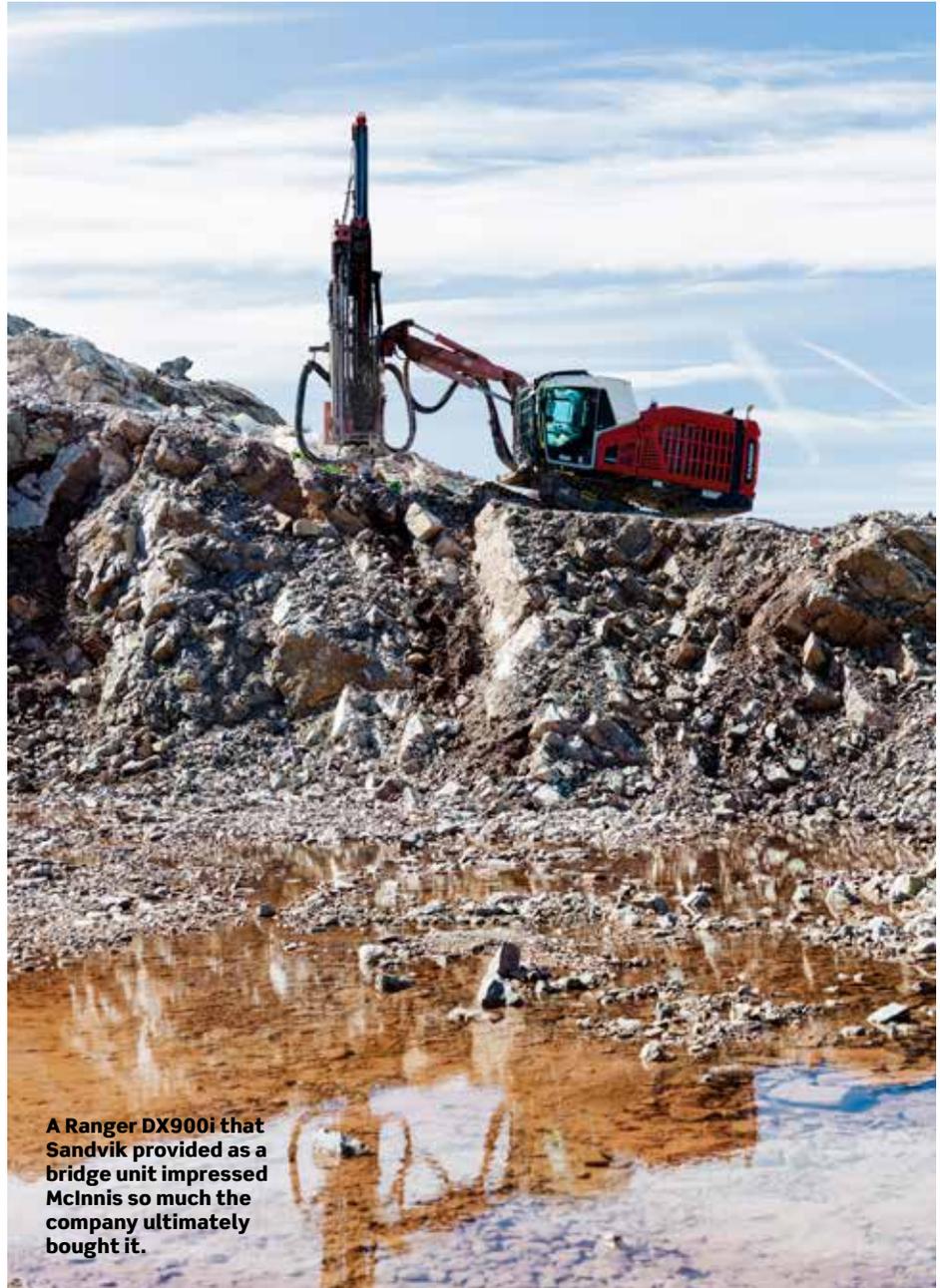
“Like all cement plants, the heart of our plant is the kiln,” he says. “The kiln is heating at more than 2,500 degrees Fahrenheit. We don’t want to stop it to bring it back up to this temperature, so once you’re running you want to keep it running for as many months as possible without stopping. For us, that means we need to keep extracting and crushing limestone.”

The 17,000-metric-ton-per-day quarry and land acquired nearby hold reserves estimated to last a century, and the limestone is covered by relatively little overburden. But the terrain is complex and creates drilling and blasting challenges.

“The topographic area, even if it’s beautiful, we’re at the top of two mountains with the land very difficult to access,” LeMoal says. “On a very small bench, you need to do 10 times more holes than on a 50-foot flat bench, so you can imagine the need of drilling due to this topography as well as the earthworks needed to go with our drill on those sites.”

A DRILL OPERATOR can achieve 1,000 feet on a 50-foot flat bench one day and only 300 feet in a more complex area the next. The chemical variation of the deposit can also complicate blast pattern planning.

“We have high-quality limestone in some places and high-silica limestone in others, so we need to mix together at the crushers for the correct mix in order to produce low-alkali clinker,” LeMoal says. “The land is also quite complicated. After all the overburden you have some natural holes, since the limestone is easily affected by rain. These holes, as well as the deformation of the



A Ranger DX900i that Sandvik provided as a bridge unit impressed McInnis so much the company ultimately bought it.

deposit, bring us in some very challenging situations sometimes.”

The cold months create yet another challenge. Last winter, McInnis had to remove 18 million cubic feet of snow.

“It was a quarry inside a quarry,” LeMoal says.

When development drilling began in 2016, McInnis purchased a Leopard DI550 down-the-hole (DTH) drill rig. It was a natural choice for LeMoal, who grew to appreciate DTH rigs at one of the biggest quarries in France before he moved to Quebec in 2013.

“It’s very productive and there’s less deviation if you need to do angle drilling, but it is also a little bit too big when you have to

go in steep areas or areas with lots of cracks, holes and faults,” LeMoal says of Leopard DI550.

AFTER TWO YEARS of productive, reliable operation at the quarry, a breakdown in October 2018 risked leaving the team unable to deliver limestone to the plant for more than two weeks.

To minimize the impact on McInnis’s production, Sandvik mobilized the best possible bridge unit it could deliver in the shortest timeframe – a Ranger DX900i top hammer drill rig from the company’s branch in Miramichi, New Brunswick.

But when the demo unit with mere hours on its engine arrived at the cement plant’s





We were amazed. We can drill a hole size other top hammer rigs can't drill, and this drill can also climb mountains



Operators such as Samuel Poirier really appreciate the 290-degree swiveling boom of Ranger DX900i.

Sustainability

Sustainability is a key focus for McInnis Cement. The plant voluntarily adheres to the stringent 2015 National Emission Standards for Hazardous Air Pollutants for new plants as established by the United States Environmental Protection Agency (EPA). Its high tower helps to preheat material and the kiln is shorter than many plants, requiring less energy to produce clinker and reducing greenhouse gas emissions.

The plant was built to be able to use wood biomass to heat its kiln, and McInnis is currently conducting a feasibility study to explore up to a 30 percent substitution of current petroleum coke consumption by wood residues in the combustion process. As many as 100,000 annual metric tons of forest biomass from local sawmills – residues including wood chips, bark and sawdust – could help reduce the plant's greenhouse gas emissions while simultaneously benefiting the Gaspé Peninsula forestry sector.

McInnis also made special considerations when developing its marine terminal to ensure local fishing spots would remain accessible, and vessel movement halts when whales are spotted in the bay. The terminal not only reduces cement transportation costs but also improves the operation's environmental footprint – one ship can carry the equivalent of as many as 1,500 truckloads of cement.



The terrain at the quarry is complex, creating drilling and blasting challenges.

front gate just four days after the Leopard DI550 breakdown, LeMoal was skeptical of its size.

“The first time we saw it on the flatbed, we said, ‘Oh no, it’s too little. We will never reach our production capacity with that,’” LeMoal recalls.

Appearances quickly proved deceiving.

“After two weeks of operation, we said, ‘Finally, we can make quite big holes with that and we can go in such lands with easy facility, less earthwork to prepare the field than for the DI550.’ So it was less time of preparation for our shovel and it was finally cheapest to go with this drill on the site. It was a great pleasure and a great surprise, also, because it was not in our consideration to look closer at this kind of drill before that.”

BY THE TIME Sandvik recommissioned the repaired Leopard DI550 just three weeks after the breakdown, the Ranger DX900i was already delivering the same productivity drilling 5.5-inch holes as Leopard DI550 had drilling 6.5-inch holes, and the new top hammer rig proved much more versatile and maneuverable.

“We want to drill as large holes as possible when we have 50-foot benches,” LeMoal says. “But when we are in very difficult area, we cannot go with this machine or it needs a lot of work or we have to call a subcontractor. With DX900i, you can have a good performance and you can have a machine which can go virtually everywhere for the size of the machine. That is what’s impressive.”

MCINNIS HAD ALREADY been planning to invest in another Leopard DI550 to increase production capacity, but “the facility of the DX900i to go on those kinds of fields got us thinking differently,” LeMoal says.

“At first, we were not entirely pleased to receive it as a temporary replacement, but we gave it a try and ultimately we discovered a good drill for our process, for our quarry,” LeMoal says. “We were amazed. We can drill



MCINNIS CEMENT

The McInnis Cement plant in Port-Daniel-Gascons, Quebec – the largest in the province – started production in 2017 and can produce as many as 2.3 million metric tons of cement annually. The initial investment combines the state-of-the-art plant as well as McInnis Cement’s network of strategically located distribution terminals in Canada and the US. Created in 2011, privately held McInnis Cement has corporate headquarters in Montreal.

a hole size other top hammer rigs can’t drill, and this drill can also climb mountains.”

The Ranger DX900i has added unexpected value to McInnis’s bottom line by eliminating the need to hire a subcontractor for precasting.

“We were thinking about using a subcontractor for our ending walls, but with the DX900i we can do this job internally, too,” LeMoal says.

MCINNIS PURCHASED THE Ranger DX900i in July 2019 as its productivity and efficiency continue to impress. The rig primarily develops flat benches that the Leopard DI550 can access more easily.

“DI550 and DX900i form the perfect match for us,” LeMoal says.

LeMoal appreciates the ability to export drilling plans from his office directly to Ranger DX900i. The rig’s fuel efficiency has also impressed the quarry manager.

“We’ve had very low consumption with the DX900i compared to DI550,” LeMoal says. “The consumption was a nice surprise and the production is quite good, too.”

Veteran drill operators Renaud Langlois

and Samuel Poirier split time in the cabs of both Ranger DX900i and Leopard DI550.

“The DX900i is an ideal size for limestone, in between the larger DI550 and a smaller top hammer rig,” Langlois says. “The new iCab is nice and quiet.”

HIS FAVORITE FEATURE is the 290-degree swiveling boom, which minimizes the need to reposition the rig from one hole to the next and enables 600 square feet of drilling coverage.

“There’s less moving to drill the holes and it’s faster for the production,” he says. “In 20 years that’s the best top hammer I ever drilled with. For all the production, it’s the best one.”

Despite his initial skepticism about Ranger DX900i, LeMoal is grateful for the blessing in disguise and Sandvik’s prompt resolution of the Leopard DI550 breakdown.

“Even at the oddest moment, Sandvik is here to support us and we still work as a team, and not just supplier versus customer,” LeMoal says. “And it is very appreciated to have this kind of relationship.” ■

SANDVIK 800i CONE CRUSHERS



Crushing connectivity



The new Automation and Connectivity System from Sandvik offers a more accurate picture of the crushing process.

Rock processors are under pressure to respond to rising challenges such as climate change, energy consumption and safety issues. Sandvik Mining and Rock Technology works hard to support the industry in these issues and help customers maintain their social license to operate. One of the tools to this end is the Sandvik 800i series of cone crushers and the new advanced Automation and Connectivity System.

TEXT: **TURKKA KULMALA** PHOTO: **SANDVIK**

GROWING POPULATIONS, DWINDLING resources and escalating ecological problems pose an enormous challenge for humankind: more must be done with less. Necessary materials must be extracted and processed cost-effectively and sustainably, with lower impact and a smaller carbon footprint.

Digitalization creates a new dimension on top of conventional business processes. We can readily connect machinery and collect data on an unprecedented scale. Tools are there, but the question is, who has the smartest solutions to utilize the astounding amount of data that we are now capable of collecting and the knowledge to process it into tangible benefits?

From an equipment supplier's point of view, this creates demand for business models and aftermarket services that truly help operators to overcome the challenges mentioned above. More and more industry professionals think less in terms of what equipment do I need to buy, and more in terms of what capability do I

need and how can I get it to meet my operational and business targets, as well as sustainability targets.

In terms of crushing processes, the Sandvik 800i series of connected cone crushers is one answer to these challenges. More specifically, the answer is the new solution created jointly by powerful and efficient crushers on one hand and the new Automation and Connectivity System (ACS) and My Sandvik customer portal on the other.

"The Automation and Connectivity System forms the foundation for any data-driven services and actions that our crushing and screening segment will offer customers now and in the future," says Petra Sundström, head of digital business development for Sandvik's Crushing and Screening division.

SINCE CONE CRUSHERS are the Crushing and Screening division's biggest product group, it was a natural place to introduce ACS. In practical terms, the mechanical expertise and



TECH SPECS

SANDVIK 800i CONE CRUSHERS

By nominal capacity and motor power

CH830i: 61–283 mtph (67–311 stph), 250 kW (335 hp)

CH840i: 103–427 mtph (113–470 stph), 330 kW (442 hp)

CS840i: 212–659 mtph (233–726 stph), 330 kW (442 hp)

CH860i: 250–910 mtph (275–1,003 stph), 330 kW (442 hp)

CH865i: 155–517 mtph (171–570 stph), 500 kW (670 hp)

CH870i: 208–1,283 mtph (229–1,414 stph), 600 kW (805 hp)

CH890i: 275–1,837 mtph (303–2,025 stph), 750 kW (1,000 hp)

CH895i: 258–1,077 mtph (284–1,187 stph), 750 kW (1,000 hp)

crushing power already available in advanced cone crushers needed to be streamlined into a unified product line and partnered with a powerful and versatile automation platform to meet present and future industry needs. This means the capability to introduce more sensors, measure more and more accurately, creating reports to give a more accurate picture of what is happening inside the crushing process so that it can be improved.

“What we are doing here is that we are actually sending the data that is generated by the cone crushers to a cloud solution, My Sandvik, for our customers to be able to access valuable reports from the data generated by their connected Sandvik crusher fleet,” says Martin Johansson, product line manager for compression crushers at Sandvik Mining and Rock Technology.

“We have now launched a platform for the digital solutions of today but also for tomorrow,” Johansson says. “Basically, we’re taking the first steps for the future to come: more sensors, more cameras and more data. This will enable business decisions based on facts instead of guesswork.”

THE SANDVIK 800i series of cone crushers, which reached its full scope with the latest expansion into eight crushers in September 2019, shares the same design philosophy, with the main focus on excellent productivity and reliability. It collects under one umbrella all of Sandvik Mining and Rock Technology’s flagship cone crushers to build a unified mechanical platform for the automation and connectivity solutions, ranging from 61 to 1,837 metric tons (67 to 2,025 short tons) per hour in design capacity and from 211 to 428 millimeters (8.3 to 16.9 inches) in maximum feed size.

Mechanically, the Sandvik 800i crushers stand out with their toughened-up main shaft and top/bottom shells. The resulting strength increase means improved reliability, better availability and a low risk of critical failure.

Details such as bolted top and bottom shell liners, instead of welded ones, enables up to 90 percent faster liner change. An over-pressure system prevents ingress of dust for increased reliability, and the standard offline filter keeps oil cleaner, extending the oil life by up to five times. Eliminating plastic backing material prevents the exposure of maintenance personnel to harmful substances during liner replacement work.

These improvements in the actual hardware are far from insignificant: they mean more output and more uptime, making for safer and more sustainable crushing. Even so, the true focus of the Sandvik 800i series is on the



The latest Sandvik 800i crusher improvements mean more output and uptime, making for safer and more sustainable crushing.

BENEFITS

- Business insight: unlock the power of your Sandvik cone crusher fleet with efficient data collection and actionable reports to optimize and improve your business performance
- Uptime certainty: the new Automation and Connectivity System gives you peace of mind, so you will know how your crushers are performing and you can avoid overloading
- Output certainty: Powerful crushing programs enable precise fractions and optimal crusher settings for any task
- Power of connectivity: My Sandvik portal offers a single point of entry for all the crucial crusher performance data and fleet management information
- Sustainable crushing: Smart mechanical solutions and superior connectivity enable safe operation and maintenance with minimal environmental impact.

automation and connectivity features. The trusty ASRi platform needed to be replaced with a new, more scalable and expandable automation platform to fully support new digital solutions.

In addition to the standard CSS regulation, the new ACS also fully integrates lubrication monitoring and control, and the option to monitor an off-line filter. Non-critical sensors can be bypassed to continue running the crusher while waiting for replacement parts. ACS also integrates the control of all subsystems to a single, more user-friendly interface. Last but not

least, the capability to access the data-generated reports from My Sandvik is significantly improved.

THE INITIAL FEEDBACK from the field is certainly promising. Representatives from the Mantos Blancos copper mine in Chile say that the new Sandvik CH870i crushers and the reports from My Sandvik jointly brought new life to the mine's sulfide crushing process, helping the operation to develop and implement its digitalization rollout. Improved analytical capabilities support more

effective decision making. Lessons can more easily be learned from fault situations, and problems can even be predicted before they have an impact on the operations.

The Mantos Blancos maintenance crews have significantly improved their predictive maintenance results, and the mine management can make better-informed, fact-based decisions in the sulfide processing circuit.

"We look forward to offering these substantial benefits for all crushing plant operators throughout the world," Johansson says. ■

A FLEXIBLE FUTURE

WALHALLA, S.C. A new dual powered mobile crushing plant has more than doubled aggregate production while improving product quality and creating unprecedented versatility for one of the only government-owned quarries in the USA.

TEXT: ERIC GOURLEY PHOTO: ADAM LACH

SIX MORNINGS A week, dozens of dump trucks wind up the aptly named Rock Crusher Road to the Oconee County Quarry.

Located outside the town of Walhalla in northwestern South Carolina, near the Georgia and North Carolina borders, the county-owned quarry produces blue granite, South Carolina's state rock.

Not only does the quarry make aggregate for county government needs that include road building, storm drainage and slope protection, it also serves more than 600 local customers, who range from paving and grading contractors to rural residents who just need a little gravel for a driveway.

"We're able to support local government needs as well as the needs of the local citizens," says assistant manager Thom Moxley. "We're very proud of that."

An aging crushing plant left the quarry struggling to satisfy demand in recent years. The 30-year-old stationary plant could only produce 270 metric tons of crushed stone per

hour running at full capacity, and it often wasn't running at all. Unscheduled downtime took a toll on production.

"We had got to the position where we were running our plant to try to meet production needs and not having enough time to do the preventive maintenance that we needed to do," Moxley says.

Moxley, colleagues at the quarry and the county administrator began discussing and researching replacement options in early 2017, comparing both stationary and mobile plants. Moxley and crew leader Billy Buchanan, who started working at the quarry within a week of each other six years ago, traveled to Sweden to inspect a dual power mobile plant in 2017.

"It's a real shift in the way of thinking; instead of taking the rock to the plant, you take the plant to the rock," Buchanan says. "The efficiency of that plant was impressive."

In February 2018, the Oconee County Council green-lighted \$7.5 million in

improvements to the quarry. Quarry staff recommended the purchase of a mobile crushing plant, and the county initiated a request for proposal (RFP) process.

THE QUARRY NEEDED a plant that would produce at least 590 metric tons per hour of finished product, including at least 180 metric tons per hour of one-inch #57 aggregate.

"Those were the stringent requirements that we had to meet for Oconee County to feel like we could make this investment," Moxley says.

The quarry also required the plant to be able to produce several other products, including #789, class A riprap and asphalt sand. The crusher run had to meet South Carolina Department of Transportation specifications for gradation in order to be used on state roads, and both the #57 and #789 also had to meet state specifications for flat or elongated particles.

Moxley and his colleagues were also





The quarry produces blue granite, South Carolina's state rock.



intrigued by the flexibility of a plant that could enable the quarry to freely alternate power supply between onboard diesel generators and the main electric network.

“Dual power machines were very attractive to us because we can be most efficient if we are on the grid,” he says. “But certain times it’s costly to be on the grid, so we could manage the different operations using diesel over electric so that we can stay off the grid during peak times. The electric is quieter, so there’s a lot of things that helped us ultimately be able to justify the dual power system.”

THE OCONEE COUNTY Council awarded the RFP to Sandvik, whose solution included a five-year extended warranty, local dealer service support, scheduled equipment inspections and comprehensive operator training.

“We just felt through the whole process that Sandvik’s technology was on the cutting edge and they make a very durable, strong product,” Buchanan says. “All the companies in the RFP sent us offers of their solutions, and Sandvik actually sent us four options. The one we went for has provided some solutions that we never asked for, and the potential to grow. In the future the quarry might need more capacity. Sandvik was looking out for us.”

The quarry invested in a mobile plant primarily because it provides pit design flexibility. The new plant can be relocated indefinitely, enabling the quarry to size, crush, screen and stockpile as close to the face as possible.

“We’re not ever going to be in a situation again that we have a stationary plant sitting on rock that we need to mine,” Buchanan says.

Moxley expects the plant to eventually reduce the operation’s diesel budget too.

“Ultimately, when we get our quarry in a



Sandvik UJ640 features an 635-cubic-foot feeder hopper extension to enable faster loading.



position to accept the equipment that we have, we can accommodate the customers there and it’s going to decrease the amount of trucking and equipment necessary to give the customer what they need,” Moxley says. “When the time comes, we can just move our plant and we won’t have to redesign a plant or start all over again. We’ll just go to a different footprint.”

SANDVIK ENGINEERED THE new diesel-electric mobile plant to a 480 V voltage and 60 Hz frequency to work with North American mains electric power.

The county upgraded the electrical system to provide the required voltage to support the

new mobile plant, which was commissioned in November 2019 and consists of a Sandvik UJ640 primary mobile jaw crusher, a Sandvik US550E secondary cone crusher, a Sandvik UH550E tertiary cone crusher, two Sandvik QA441e Doublescreens and three mobile stackers. All mobile crushers feature Sandvik’s renowned crushing technology at their core.

“Each of those models were considered for growth and to be able to network with other pieces that may come into the puzzle, or other models that may be added to our plant, so it was a very well thought through process that the whole Sandvik team worked on,” Moxley says. “Sandvik ensured that the jaw

” Instead of taking the rock to the plant, you take the plant to the rock



was not going to be the bottleneck in our operation. We can actually grow with the jaw over the coming years. We wanted about 590 metric tons an hour, which was going to more than double what we make now, and we feel like there's 770 there in the future."

The quarry's Sandvik UJ640 features an optional 635-cubic-foot feeder hopper extension to enable faster loading and provide a surge pile to ensure a continuous feed to the Sandvik CJ615 single-toggle 1,500-by-1,100 millimetre jaw, maximizing throughput and efficiency. The unit is also fitted with an optional Sandvik breaker and boom for clearing blockages and removing bridged rock.

"It is a very deep jaw that can accommodate a larger 97-centimetre (38-inch) single-grain stone," Moxley says. "The design of it has been in such a way that all of the vibration is absorbed through the track system. And with it being up-sized and not having to work as hard as a jaw would have to work, it just methodically does its work without very much effort. We feel like the jaw could actually have a larger excavator to feed it. It's producing so quickly."

UNTIL THE QUARRY opens its face, material from the jaw is trucked from the base of the 300-foot pit to a stockpile, where a large wheel loader feeds Sandvik US550E. The secondary crusher's dual interlocking and intelligence system is integrated with Sandvik's Automatic Setting Regulation (ASRi) control system to automate process optimization and help predict maintenance issues, maximizing uptime.

"The Sandvik plant is really something you can just set and forget," Buchanan says. "We are confident in the ASRi system that it's going to help us monitor. It's made life easy. There's very few manual tasks that we have to do anymore, and all that is available through technology Sandvik offers."



Sandvik US550E feeds into Sandvik UH550E. Both cones feature a box that enables the quarry to make a final product.

"We don't even have to push it forward to our screeners, so that gives us even that much more versatility," Moxley says. "We're actually thinking about possibly adding a product or two maybe that we don't currently produce."

Not only have the reduction ratios of the secondary and tertiary cones impressed the quarry, but Buchanan, who oversees its quality control program, says the stone produced by the new mobile plant is measurably more cubical – an essential characteristic for road sustainability.

"We have to hit our production goals, but also equally as important it can't be flat or elongated," Buchanan says. "We have multiple studies that show that roads will deteriorate much, much quicker if they're flat or elongated products. The feeder on the Sandvik cones has a level sensor. It takes out

the possibility of human mistakes. The feeder is always going to provide the cone with the exact same amount of rock, the exact amount of rock it needs to make sure that it's crushing rock on rock and getting a cubical product. With the old plant, it was simply impossible."

THE ABILITY TO choke-feed the new cones more efficiently has virtually eliminated the issue.

"Our flat and elongation rate on our old plant was roughly 14 percent," Buchanan says. "With the Sandvik product so far, we're around 4 percent. A massive improvement."

A splitter chute mounted on the back of two Sandvik QA441e screens divides material from the tertiary cone and, in conjunction with the patented Doublescreen system, enables the quarry to produce #57 and #789 simultaneously.

Each of the three 79-foot mobile stackers ultimately creates a 5,400-metric-ton stockpile.

The stone produced by the new mobile plant is more cubical, which is essential for road sustainability.



“That reduces the need to move the product,” Moxley says. “We can actually sell directly from there.”

Two months after decommissioning the obsolete stationary plant, Moxley says the new mobile plant is providing unprecedented versatility for the quarry.

“We can concentrate on products and we can push materials in a different direction to optimize the output for the production that we need,” Moxley says. “We find new things daily that we’re capable of doing that we didn’t have the ability to do in the past. Modern technology is amazing. We’re very fortunate now to have a new plant that can more than double the production that we were making.”

Buchanan echoes Moxley’s sentiments.

“We were looking to better ourselves through technology and I think that’s what we have with Sandvik,” Buchanan says. “I’ve been very pleased with Sandvik. It was fantastic from the start and I’m very confident with our relationship going forward. We looked at several companies and Sandvik had the best products. Plus, I’m very confident that we have a partner that is going to take us for the next several decades.” ■

The Oconee County Quarry is one of the only government-owned quarries in the US.



OCONEE COUNTY QUARRY

In operation since 1948, the Oconee County Quarry sits on 100 acres in rural north-western South Carolina. The quarry sold approximately 480,000 metric tons of stone in 2019 and is currently permitted through 2050, with rock reserves estimated to last until around 2100.

SANDVIK DT1132i



THE TOTAL PACKAGE

While dedicated equipment sometimes has its merits, the trend of the day is to use tunneling jumbos for many jobs. The fully automated Sandvik DT1132i fits the bill with a well-balanced package of accuracy, drilling power, safety and ergonomics.

TEXT: TURKKA KULMALA PHOTO: SANDVIK



Sandvik DT1132i lends itself to a wide range of tunneling jobs and other underground applications.



THE CURRENT DEVELOPMENT trends in tunnel drilling call for equipment to be as versatile as possible. A single drill rig should preferably be capable of face drilling and bolt hole drilling as well as longhole drilling jobs. Another key requirement is the ability to collect data while drilling, analyze it onboard or in the office and utilize it for applications such as quality control purposes, 3D profiling and water loss measurements.

Sandvik DT1132i is a new large tunneling jumbo, nearly four meters (13 feet) tall and up to 20.56 meters (67 feet) long, that caters effectively for these multiuse and connectivity requirements.

“We designed Sandvik DT1132i to offer high productivity without compromising drilling accuracy and drilling automation, which have always been the strengths of our tunneling jumbos,” says Tommi Salo, product manager, underground tunneling drills at Sandvik Mining and Rock Technology. “The use of common platform components was also one of the project targets to ensure good spare parts availability.”

SANDVIK DT1132i LENDS itself flexibly to a wide range of tunneling jobs and other underground applications, including fast face drilling, mechanized longhole drilling and bolting. In Nordic markets, nearly half of all the drilling in a tunneling project can consist of longholes for high-pressure grouting to prevent water leaks caused by groundwater or bodies of water above the tunnel. Sandvik DT1132i offers much-needed agility for these tasks.

Dozens of features and details have been completely redesigned or improved for higher productivity, better usability and improved safety, Salo says.

“One example is the new drilling system which includes new booms, new rock drill and drilling tools,” he says. “Also, on the carrier side we have updated the powerpacks and flushing systems to support high-power drilling while managing to keep a good efficiency rate to save energy.”

STARTING FROM THE “business end” of the drilling action, the new Sandvik Alpha 360 bits and GT38 rods are specifically optimized to convey the full power of the new RD535 rock drill to the bottom of the hole. The new, bigger bit thread enables better support for the bit and straighter holes. The optimized rod diameter and new coupling guide also improve accuracy through a reduction of up to 50 percent perfection in the hole deviation. Overall, the new tools enable markedly higher advance rates for each blast.

In addition to the new tools, the new RD535 high-frequency rock drill lays a solid foundation for Sandvik DT1132i’s productivity. The patented percussion mechanism provides efficiency and power, while the stabilizer structure, also patented, saves tools. The excellent ratio of input and output power transfer cuts energy consumption by up to 20 percent. The long service interval, 400 percussion

TECH SPECS

SANDVIK DT1132i

Coverage: 190 square meters (2,045 square feet)

Rock drill: RD535, percussion power 31 kW

Powerpack: 3 x 90 kW IE3

Diesel engine: Cummins B6.7, 168kW (stage 5)

Transmission: Hydrodynamic

Control system: SICA: intelligent torque control and feed percussion control

Monitoring and fleet management: Readiness for My Sandvik cloud service

Process optimization: iSURE tunnel management software

Weight: 50,000–56,000 kg (110,000 – 123,000 pounds)

hours, directly translates to higher productivity. Combined with improved flushing and efficient cooling, RD535 offers uninterrupted high-speed drilling.

The rock drills and tools are supported by the new feed system, TF535i, and the equally new boom, SB160i. The boom combines the excellent positioning accuracy (+/-5 centimetres/1.96 inches) of Sandvik’s stiff square shape boom with a patented front “wrist” for increased coverage and flexibility of movements. The optimized hose and cable routing

The new RD535 rock drill cuts energy consumption by up to 20 percent.



BENEFITS

- Up to 20 percent faster drilling rates: reduced operator and energy costs
- Maximized utilization by up to 25 percent larger side coverage
- Up to 50 percent straighter holes for major cost savings, from reduced underbreak to less shotcreting and less rock to load and haul
- Helps to respond to customers' documentation needs by effective measurement-while-drilling data collection and onboard analysis
- Excellent ergonomics and safety help to attract and keep qualified workforce.

and reel structure, individually adjustable hose support structure, automatic greasing of joints as well as easily adjustable and changeable slide pieces provide excellent maintainability.

THE CARRIER VEHICLE also features several flexibility and productivity improvements. The power plant, a Cummins B6.7, 168kW diesel engine (stage 5), can be operated at up to 5,000 meters (16,400 feet) above sea level without any modifications, while cutting NOx emissions by up to 90 percent and particulate matter emissions by more than 90 percent, compared with stage 3 engines. A multi-voltage electrical system (400 to 1,000 V) helps Sandvik DT1132i to adapt to many types of worksite infrastructures and, along with the new 90-kW IE3-compliant electric motors, improves energy efficiency.

Safety and ergonomics are key aspects in all areas of the new jumbo. The vibration-dampened FOPS cabin is designed specifically for Sandvik DT1132i and offers excellent visibility and a low noise level (less than 75 decibels). An EU6/7-compliant filtration system minimizes dust concentrations inside the cab. All essential diagnostics information, on both the drilling system and the carrier, is integrated in a single display to make maintenance as easy as possible. Physical maintainability is accounted for by a new cover design that enables easy access to all service points from all directions.

Like all Sandvik i-series drill rigs, Sandvik DT1132i offers excellent data acquisition and



The vibration-dampened FOPS cabin offers excellent visibility.

connectivity capabilities with two automation levels, the standard Gold package for operator-controlled boom positioning and the optional Platinum package for full face drilling automatics. Both options feature powerful control and measurement systems for torque-based drilling, drilling depth and angle, drill bit location, drill plan visualization as well as rig navigation – in other words, more accurate drilling.

“Drilling accuracy is something that we have always focused on, because quality drilling means savings pretty much across the board: tunnel reinforcing, rock loading, haulage and so on,” Salo says.

THE AUTOMATION AND connectivity features team up with iSURE – the intelligent Sandvik Underground Rock Excavation software – which produces all the data needed for an

optimized drilling and blasting cycle. This offers a highly networked and automated workflow where drilling plans are uploaded by wireless data transfer, while the fast and adaptive drilling control capabilities boost productivity in varying rock conditions and the as-drilled data can be used to support fact-based decision making. Furthermore, My Sandvik can add monitoring and fleet management capabilities to utilize the data for optimized and cost-efficient maintenance operations.

Salo is confident of the significant value that Sandvik DT1132i can offer. “We have proven in field tests that Sandvik DT1132i brought 15 percent more production in the same time interval compared to the old models,” he says. “Also, the new user interface is simpler and easier to use, and boom kinematics are better and faster to do boom positioning.” ■

KEEPING IT QUIET

Noise is a constant presence in today's industrialized world. With regard to rock excavation and processing, the key question is how to minimize the potentially significant health impacts on operators and other worksite personnel as well as people in surrounding communities.

TEXT: **TURKKA KULMALA** PHOTO: **SANDVIK**

MORE THAN HALF of the global population and three out of four EU citizens currently live in urban areas, exposed to high levels of noise, or “unwanted or harmful outdoor sound created by human activities,” as defined in the EU’s Environmental Noise Directive. Besides being a nuisance, noise is linked to several direct and indirect health impacts. Sleep disturbance caused by nighttime noise in particular has negative effects on health. According to the World Health Organization (WHO), the onset of such impacts can be detected in people exposed to nighttime noise levels of more than 40 decibels – a fairly low figure, considering that normal conversation typically causes a noise level of around 50 or 60 decibels. Health impacts linked with noise include all kinds of ailments ranging from cardiovascular disease to psychological problems. According to the European Commission, noise can be associated with an estimated 70,000 hospital admissions and 16,000 premature deaths per year in Europe alone. Indeed, the WHO categorizes noise as the second-worst environmental cause of ill health, surpassed only by ultra-fine particulate matter air pollution.

In other words, noise is not a second-rate problem of minor significance. What can we do about it then? More specifically, what can mine managers, quarry operators and drilling contractors do to reduce the noise emissions from their surface drilling equipment? The key points in any noise problem, and consequently the factors that any control measure needs to have an impact on, are the source, the transmission path and the receiver. A mine owner or a blasting contractor obviously has little or no control over off-site prevention measures – it is not feasible to make people in the neighborhood stay indoors or use hearing protection. The drilling crews and other worksite personnel are of course responsible for using correct working methods and personal protective equipment. In other words, the most practical mitigation options are at the source and in the transmission path.

A SURFACE DRILL rig is a challenging application in terms of noise mitigation because it is very difficult to design the rock drill, by far the most significant source of noise, in a way that would effectively dampen the loud noise emitted during drilling. “We

have looked into this a lot with Sandvik,” says Lasse Lamula, a senior scientist at the VTT Technical Research Centre of Finland, a research institution with which Sandvik cooperates closely. “Our conclusion is that it is very difficult to effectively reduce the noise level from the rock drill. The drill rod in particular emits a lot of noise all-around. The issue is that making the rock drill robust and durable on one hand and reducing noise on the other are conflicting goals. Generally, what you try to achieve in mechanical engineering is to reduce the surface vibration levels of the machine components, but in rock drills this is very difficult to accomplish.”

THIS LEAVES THE third option, reducing noise along the transmission path. Practically this means isolating the rock drill and rod handling system inside an effective noise-suppressing structure. But even this is complicated because designing such a structure is also not a simple task. “There are so many parameters that you need to factor in,” Lamula says. With an example from the recent Sandvik NoiseGuard-DXi project, he mentions that the noise levels emitted directly in front of the rig were clearly





ZERO HARM

One of Sandvik Group's sustainability targets for 2030 is presented under the heading "People": the company aims for zero harm to people, regarding both its own operations and those of the customers. In terms of customers, this means that health and safety improvements are an integral part of all product development projects. Furthermore, health, safety and risk analyses must encompass all products and services.

The NoiseGuard-DXi silencer can reduce the sound power emitted from the rock drill to a level that is just 16 percent of the non-mitigated value.



higher than in other directions and no clear explanation for this was found, even though the matter was examined closely. Improvements to the silencer design did not result in any substantial results. The mass of the enclosure wall structure is the most crucial factor, as a heavier structure mitigates sound more effectively. But again, there is a competing requirement to make the silencer as light as possible. Furthermore, it is problematic to make a light structure rigid to reduce resonance and at the same time minimize sound radiation efficiency.

One key goal is to maximize the absorption of sound inside the silencer structure by using optimal materials, which is something Lamula credits Sandvik silencer solutions with. “It seems to work incredibly well,” he says. “The reductions in sound power we have measured are truly astonishing, considering the relatively simple structure of the silencer. Furthermore, the subjective sensation that a drill operator hears when using the rig can be even more significant, compared with the measured values.”

THE PRODUCT RANGE from Sandvik Mining and Rock Technology includes several effective solutions that can significantly reduce the noise levels of surface drill rigs. A solution called NoiseGuard-DX has been available for Ranger DX series top-hammer drill rigs for

several years. The new Ranger DXi series rigs can be equipped with an upgraded solution, called NoiseGuard-DXi, which is a fully enclosed structure and provides at best close to 10-decibel noise reduction in the A-weighted sound pressure level around the rig. The NoiseGuard-DXi option integrates effective noise suppression with the latest usability features such as a camera system to provide excellent visibility inside the silencer enclosure even with closed doors as well as a single-bolt dismantling design for fast and easy maintenance on the feed system. A third solution, called NoiseShield-DC, is a simple, compact solution for the smaller, cabinless Dino DC410Ri drill rigs. While not a fully enclosed structure like NoiseGuard-DXi, NoiseShield-DC still effectively reduces noise levels by directing the drilling noise upward through an open top, away from the operator and surrounding areas.

COMPANIES ACTIVE IN the quarrying and mining industries are becoming increasingly aware of the significance of noise emissions. One example is Suomen Räjätyslouhinta Oy, a Finnish blasting and excavation contractor active in a wide range of quarrying, civil engineering and building construction jobs. “We no longer welcome rigs without silencers,” says Jyrki Peltola, managing director of Suomen Räjätyslouhinta. “Silencers have a

DECIBEL AND SOUND POWER

The A-weighting filter referred to in the noise measurements of this article is a method designed to filter sound energy across the frequency spectrum audible to humans in such a way that the measurement results correspond more realistically to the sensitivity of the human ear to sound. Due to the logarithmic nature of the decibel scale, changes that may seem insignificant at face value are actually rather substantial; for example, the NoiseGuard-DXi silencer can reduce the sound power emitted from the rock drill by eight decibels, which means that the absolute sound level is just 16 percent of the non-mitigated value.

notorious reputation for being problematic, but that’s just idle talk. I would say go and ask any driller here and they will tell you it’s no problem. It doesn’t affect drilled meters, comfort, nothing. It has many benefits besides just noise reduction. It also affects the amount of dust. The drill operator is also able to work longer in a more pleasing work environment. And of course nowadays, silencers are being called for in city contracts. It’s the future.” ■



Correct the comminution

How will an industry that extracts our planet's raw materials become more sustainable? To make meaningful change happen, it's time to tackle one of the world's biggest users of energy: comminution.

TEXT: DAVID NIKEL PHOTO: ADAM LACH

PROGRESS HAS BEEN made throughout the mining industry to reduce emissions. But as the world's population soars and urbanization continues as a global trend, demand for raw materials continues to rise. Access to those raw materials is becoming ever more challenging, so the importance of sustainable practices is increasing.

Sustainable economic, environmental and social development is vital to meet the needs of today without compromising the ability of future generations to do the same. To maintain our current way of life, more raw materials need to be extracted and processed, consuming more energy and water and producing more waste. As we mine deeper for lower-grade

materials, the problem compounds. Balancing this need for materials with the need to reduce energy use and conserve water is a major sustainability challenge. While the concept of sustainability in an industry that extracts raw materials is something of a paradox, further environmental improvements are possible in mining and aggregates. For these industries, addressing comminution, one of the world's biggest users of energy, is a good place to start.

COMMINUTION — THE process of reducing rock size — is required to extract valuable minerals for processing and to upgrade the ore for industrial applications. It starts with blasting followed by crushing and the grinding or milling of the mined rock. Mining is an energy-intensive industry that uses around 7 percent of world's generated energy. Of this, almost half goes to comminution. Innovation is needed to reduce energy consumption from the currently inefficient comminution process.

As a key technology partner to the industry, Sandvik has an important role to play in leading the change. Since 2011, Dr. Hamid-Reza Manouchehri has worked at Sandvik to improve eco-efficiency and productivity with respect to energy and water use in comminution. He believes that for a more efficient

20%

Amount of energy consumption saved in milling by reducing the size of the crushed product from one-half inch to one-quarter inch.

comminution process, you have to look at the entire value chain, and that starts before you even begin to drill. “With 2 percent of energy consumption but 15 percent of total operational cost, blasting is the most energy-efficient comminution process,” Manouchehri says. “But we can still make improvements that benefit the processes further down the chain. A good-quality blast creates good fragmentation, which reduces the cost of transportation and makes crushing more efficient and productive,” says Manouchehri.

Sandvik Mining and Rock Technology has introduced a new adapter to improve the level accuracy of drilling, with promising results so far. Straighter drilling preserves energy and reduces cost while giving better fragmentation. Drilling at even a slight inclination means you have to drill more and work longer to stay on track. A detailed study revealed that over an eight-year mine life, the adapter could reduce the drilling required by as much as five miles and improve blast quality, reducing haulage cost and energy consumption in subsequent comminution processes.

ANOTHER AREA FOR improvement is obtaining data from the response of the drill bit with respect to the rock. Sandvik develops measurement-while-drilling (MWD) technology to reveal information about the chemical composition of the rock to complete characterization and improve the planning process. Such data enables smart blasting. “Designing a blast pattern based upon chemical and physical characterization of the rock means you can end up with smaller fragments of the high-grade ore, with the remainder blasted coarser,” Manouchehri says. “Smart screening or bulk sorting can remove the larger particles, reducing the amount of material to be crushed,

milled and processed. This reduces energy consumption and increases recovery in downstream processes, benefiting productivity and costs.”

Grinding and milling is expensive and not energy efficient, especially when compared with crushing. Energy efficiency in milling is no greater than 5 percent, whereas crushing can be at least 10 times more efficient and cost effective too. From the perspective of both sustainability and cost, it is logical to steer the comminution process toward blasting and crushing whenever technically possible. That opens a great window of opportunity for Sandvik Mining and Rock Technology to develop solutions in these areas.

Sandvik has designed breakthrough crushing technology with smart automation systems to improve productivity and efficiency in fine crushing. The automation system allows automatic adjustment of the crusher to deal with hard rocks, which can increase productivity by as much as 4 percent. New powerful crushers, such as Sandvik CH860i and Sandvik CH865i, can transfer higher pressure (30 percent more than similar classes of crushers) to deal with hard and competent rocks. By providing smaller-sized particles for the milling stage, a considerable amount of energy can be saved. If the crushed product can be downsized to one-quarter inch from one-half inch, it would be possible to reduce the energy consumption in milling by 20 percent. Doing that also helps minimize wear, reducing operational costs.

ATTEMPTS HAVE ALSO been made to develop efficient flowsheets by making use of different assisted technologies. Technologies such as microwave irradiation, high-energy electric pulse, ultrasonic treatment and even imple-

menting plasma technology for pre-weakening rock have all been tested. “Microwave or high-voltage electric pulse technology can create micro-fractures in the rock, weakening it to make the crushing and milling processes less energy-demanding,” Manouchehri says. “I think we’ll see rapid development of microwave technology in the mining industry over the coming years.”

While reducing energy use is crucial, it’s not the only sustainability issue. Comminution also requires large amounts of water. While many mines make use of wastewater treatment facilities, the better option is to reduce the need for water in the first place. “Over the last 70 years, average annual availability of water has dropped from around 1 million gallons per person to just 250,000 gallons per person,” Manouchehri says. “Yet the mining industry uses





Researching a sustainable future

Sandvik is leading or involved in a number of international research projects with universities and mining companies to increase sustainability in rock processing. These include evaluating and testing pre-weakening microwave technology to make the crushing and milling processes less energy-intensive, and developing a proof of concept for dry eco-efficient comminution processes.

between 1.6 trillion to 2 trillion gallons of water every year. Much of it is used as the first grinding aid during milling because it's effective and easy to handle. However, water scarcity and the potential of polluting the wastewater during milling means there's a clear industry trend towards dry comminution."

Sandvik Mining and Rock Technology is working with European partners to prove the concept of a dry eco-efficient comminution process. "I believe this dry process will reach the market and find its place within the industry," he says. "However, in order to achieve full eco-efficient comminution, each comminution process from blasting to fine grinding must be integrated and considered as one chain."

With the planet's available resources becoming ever more difficult and expensive to access, some in the industry are looking to the

far future to answer the sustainability questions of today. Advances in the oil and gas industry and related fields such as offshore wind could make subsea mining economically viable in the near future. Longer-term, asteroid mining could move from the pages of science-fiction novels to a genuine possibility. For either model to become viable, complex multidisciplinary research and development projects are needed.

OF COURSE, SHORT-TERM solutions are needed too, but even here the answers may lie outside the current mining research environment. "We need to be more innovative to make alliances beyond the current mining research infrastructure," Manouchehri says. "The global nature of the industry can provide a framework to build the multidisciplinary, team-based approach for successful R&D and innovation." ■

Measurement-while-drilling with OptiMine

Sandvik OptiMine Drill Plan Visualizer shows existing plans and actual drilling results in a 3D format, including measurement-while-drilling (MWD) data, when available. MWD data is also available in 2D graphs for more detailed alternative analysis of the drilling results. Editing of new drilling plans is convenient and quick.

Tunnel building, then and now

Building a structure underground instead of in the open air can be a tricky business. In spite of this, people have been building tunnels since antiquity – initially for irrigation purposes and later to transport people, animals and goods. Tunnel building is so widespread that builders even have their own patron saint and protector, Santa Barbara.

Some of the earliest documented tunnels date back to around the 22nd century BC, when the Babylonians started using underground passageways extensively for irrigation. Between 2180 and 2160, they successfully dug a 3,000-foot-long tunnel under the Euphrates River. In 312 BC, Rome got its first aqueduct, and even though the technology was not invented by the Romans themselves (early aqueducts can be traced back to the Assyrians in the seventh century BC), they were the architects of its advancement.

Moving forward to the 17th century, the French and the British started using gunpowder to excavate tunnels, but it wasn't until 1867 that tunnel building truly boomed. Why? Because this was the year in which Swedish engineer Alfred Nobel patented dynamite, making the process of blasting through dense materials such as rock considerably less cumbersome.

We have taken a closer look at some of the most trailblazing modern-day tunnels from around the world:



Statues of Santa Barbara are often placed at the tunnel opening to watch over the tunnel and those working within it during construction.

Lærdal Tunnel, Norway, longest road tunnel (pictured)

Running under the majestic mountains and magnificent fjords of Norway at a remarkable length of 15.2 miles, the Lærdal Tunnel is the world's longest finished road tunnel. It took some 5,000 separate blasts to complete this monumental feat of modern engineering. Built between 1995 and 2000, the tunnel connects Aurland and Lærdal, providing a ferry-free link between the country's major cities of Oslo and Bergen. The tunnel features unique design developments for ventilation and driver safety, including 15 turning points, 48 breakdown turnouts and special lighting.

Delaware Aqueduct, New York, longest working tunnel

At 13.5 feet wide and 85 miles long, the Delaware Aqueduct is the longest working tunnel in the world today. Constructed between 1939 and 1945, the aqueduct continues to carry up to half of all the water supplied to New York City, amounting to a staggering 1.3 billion US gallons, or 4.9 million cubic meters, per day. The water it supplies comes from the watershed Roundout Reservoir, and the Cannonsville, Neversink, and Pepacton reservoirs via the Delaware and Neversink tunnels.

Channel Tunnel, UK/France, longest undersea section

Completed in 1994, at a cost of GBP 4.65 billion (equivalent to approximately \$15.6 billion today), this 31-mile tunnel runs under the English Channel and links Folkestone, in Kent, England, with Coquelles, Pas-de-Calais, near Calais in northern France. It is the world's 13th-longest tunnel currently in use and the fourth-longest used by rail passengers. Coming in at just under 24 miles, its undersea section is the longest of any tunnel in the world today, recording an average depth of 160 feet below the seabed.

Tomorrow's tools and services today

Productivity is paramount for you and your mining or quarrying operation. With a diverse range of equipment, software and services, Sandvik Mining and Rock Technology not only knows your business and challenges but has the portfolio to help you augment productivity and improve safety and efficiency.

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 tunneling 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 meter 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 TUNNELING

Always advancing.

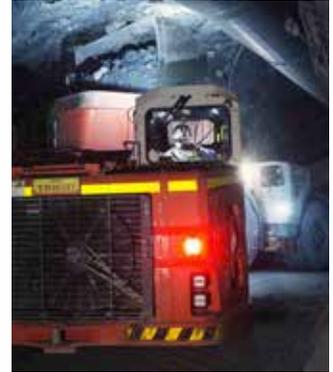
Sandvik continuous mining and tunneling equipment reflects the unique advantages of total in-house control over the equipment and cutting tools alike. Optimized cutting technology and machine design result in high productivity, long service life and low total costs.



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 maneuverable, the ergonomic products offer enormous capacity for their size and return a very low cost per ton.



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 tons 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 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, tunneling, 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.





SOLID GROUND ONLINE CUSTOMER STORIES THAT MATTER

Check out solidground.sandvik, featuring compelling stories from surface mining to tunneling, perceptive people profiles and films with the latest technological innovations. Solid Ground online is your source for global mining and rock excavation industry stories that matter to you.

