MINING & CONSTRUCTION

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Atlas Copco

Global demand heating up for energy wells

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Digitalization the key to efficiency

THE OLD SAYING "necessity is the mother of invention" couldn't be more appropriate in these difficult times for the mining industry. As the global prices for commodities continue to remain at a low level, every aspect of the business is being scrutinized in the search for even greater efficiency and cost-effectiveness.

IT'S QUITE A CHALLENGE because companies are not only under pressure to improve their profitability, they also have to satisfy ever-increasing demands for safety and environmental friendliness. At Atlas Copco, we are doing all we can to provide innovations that offer increased automation, remote control and lower running costs. But we are also playing a major role in helping companies to leverage digital technology as a means of improving the productivity and cost-effectiveness of their operations.

A GOOD EXAMPLE of this is our Certiq remote monitoring system that was recently introduced to the industry at this year's Bauma trade show in Germany. Certiq is a telematics system that enables managers and owners to keep track of the performance and status of their equipment at all times, both above and below ground. The data is then used as a decision-making tool for ensuring more efficient use of resources together with proactive service and maintenance, which reduces downtime as well as the cost of ownership.

BUT CERTIQ IS ONLY THE FIRST LINK in our chain of customer connectivity. Next comes RigScan, our digitalized and standardized audit solution for checking the health of equipment and triggering requests for the service and parts needed to keep those machines up and running. The final link in the chain will be cloud-based platforms providing technical documentation and spare parts lists, together with an integrated facility for online purchasing and order tracking of the parts recommended by the RigScan audits ... and much more.

IT'S QUITE CLEAR THAT we cannot predict what the age of digitalization holds in store. But what we do know is that the potential gains of utilizing modern technology are too great to ignore, and that the early adopters stand to gain the biggest advantages. Therefore, I recommend all our customers and others to embrace it. Digitalization might just be the answer to the many challenges we all face, and to reaching our common goal of sustainable productivity.

MARKKU TERÄSVASARA
President
Atlas Copco Mining and Rock Excavation Service division

In control, from any place, any time: Certiq enables equipment owners and managers to track the performance of their fleets and lower costs through proactive service and maintenance.

JUST A CL

Certiq takes fleet management to the next level

Certiq, Atlas Copco's new machine monitoring system, keeps equipment owners continuously updated on the performance of their fleets, paving the way for proactive maintenance and lower costs. Lhoist, owners of the Chaux de Provence quarry in the South of France, is a typical example.

The time: 5 am. The place: Provence, France. Drill rig operator Gabriel Gonzalez is already up and pulling on his overalls. He then drives to a local quarry and starts up his Atlas Copco SmartROC C50 drill rig. It is now 6 am.

Meanwhile, Benjamin Dubar, who owns the rig, is somewhere else on the planet, perhaps in another time zone. But he is just one click away from the action.

Dubar is Plant Director for Lhoist Southern Europe, the international contractor that operates the Chaux de Provence limestone quarry. And even when he is many miles away on business, he needs to stay on top of things.

For example, he wants to know the position of his rig, its fuel status, engine and hydraulic oil pressures, and whether there are any alerts that may need immediate attention.

He also wants to know how many holes have been drilled, and to what depth so that he can start up the blasting operation at exactly the right time.

All this data is now easily accessible, provided he has access to the Internet. And this is the way drilling is being increasingly managed in the 21st century.

Real time data

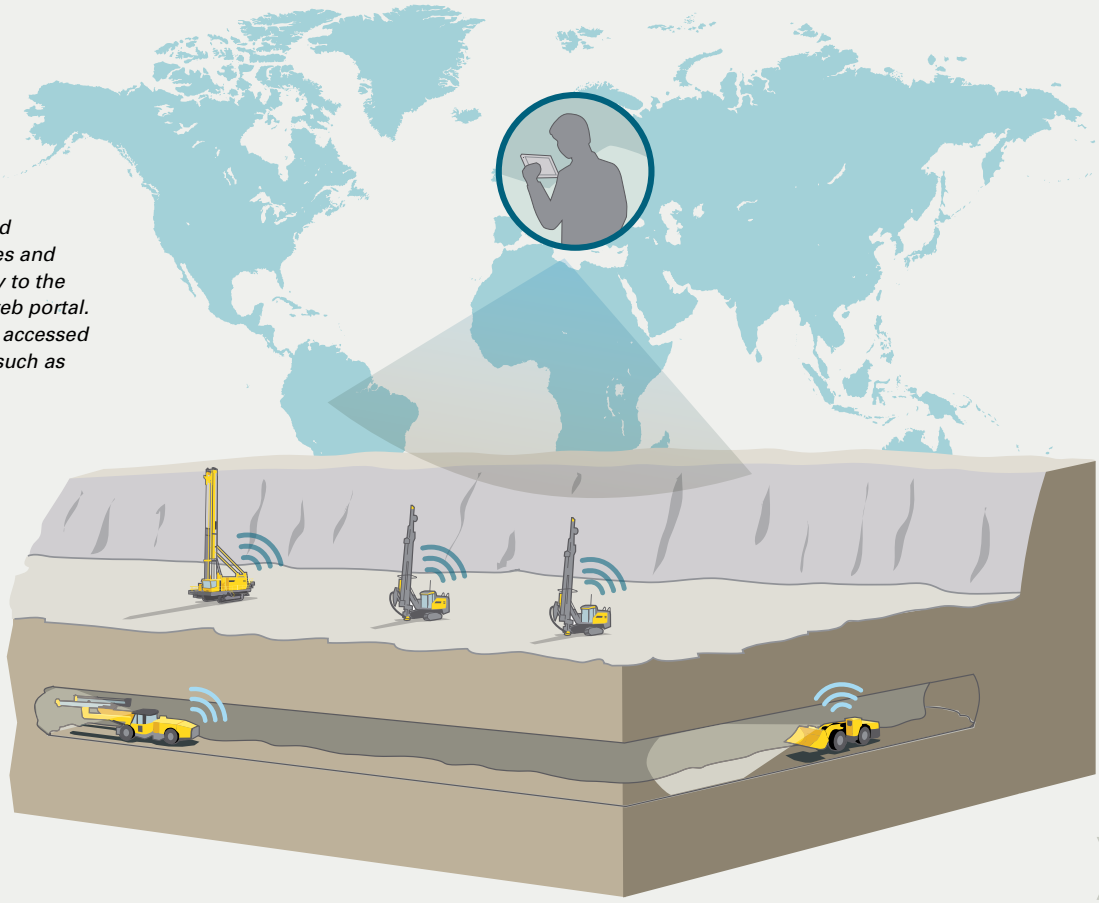
Lhoist is one of many European companies to be making use of Certiq, Atlas Copco's new telematics* system, and gives equipment owners like Dubar a complete overview of his operations in real time, 24/7, from anywhere in the world.

Certiq gathers, compares and communicates vital equipment data to the user via a web portal. The information is presented as tables, graphs and bar charts for each individual machine in the fleet.

From now on, Atlas Copco will be successively rolling out the Certiq system on the majority of its mining and construction equipment, both for surface and underground applications.

The advantages of this are plain to see. For example, maintenance can be truly proactive as it can be organized in real time. This reduces downtime, and enables maintenance to be carried out at the most convenient times of the day. Troubleshooting can be done from

ICK AWAY



Information is gathered from multiple machines and communicated directly to the user via a dedicated web portal. The portal can also be accessed using mobile devices such as Windows tablets.

Peace of mind: With Certiq mounted on this SmartROC C50 in the Chaux de Provence quarry, the rig is continuously gathering data, enabling its owner, Lhoist, to improve service and maintenance planning. From left: Operator Gabriel Gonzalez, Plant Director Benjamin Dubar, and Atlas Copco's Matthieu Pasquazzo.

» a distance, aided by alerts and historical data archived in the system. And it also helps company's like Lhoist to identify areas that are in need of improvement, perhaps requiring additional operator training.

LHOIST – A WORLDWIDE COMPANY

Lhoist is a family-owned company founded in 1889 in Belgium. Today it is active in 26 countries in Europe and the Americas and is making inroads in South East Asia. Lhoist operates over 100 plants worldwide.

The quarry at Chaux de Provence is a typical operation, producing about 800 000 t/year of limestone in various forms. This is done with a high level of mechization and automation throughout the production process, from rock drilling to calcination.

Most of the product is exported to the paper industry while the rest goes to steel making in Provence as well as a variety of local industries. Concern for the environment is also a Lhoist priority and was clearly reflected in its choice of equipment.

Two versions

There are currently two versions available, basic and professional. The basic version offers information on location, drill hours, engine operation hours, and number of alarms. The professional version goes further, providing processed data, sending text message alarms and compiling Excel reports for e-mailing to owners.

The professional version also includes a customizable dashboard showing data such as total drill meters, meters drilled per hour and day, fuel consumption as well as a map of machine positions and sites. The system shows the actual positions of surface drilling equipment and locations for underground mines.

Early adopter

The SmartROC C50 surface drill rig was an early adopter of Certiq and was delivered to Lhoist in 2015. Quarry Manager Joel Martinez, who was in charge of testing the system, opted for the professional version.

In addition to Chaux de Provence, the rig is used at two other Lhoist sites in France and is estimated to operate around 1 000 hours per year.

All operations are covered by Atlas Copco service agreements for rock drilling tools and rig maintenance. An Atlas Copco technician also services the rig at 250 hour intervals.

The data that is gathered and presented by Certiq is used as an information hub to guide the efficiency and timely supply of parts and maintenance.

Dubar says: "I was very conscious of my responsibility to choose the right rig for the Provence operations. With a single machine covering three sites, I could not allow downtime to become an issue."

It also meant taking a bold decision to

change equipment, method and supplier. The company tried a number of drill rigs from various manufacturers before opting for the Certiq-ready, SmartROC C50 with COPROD.

"Certiq allows us to get technical assistance without time and mileage to the benefit of everyone concerned," Dubar points out. "I think it is potentially a very important development. We have only been using Certiq here for a few months but already I can see that it has many advantages. It will be very useful to be able to check the status of our machines wherever I happen to be at any time. But more importantly it should lead to more proactive service and maintenance which we believe will reduce our costs."

Besides Certiq, Dubar says he was attracted by the SmartROC C50's low fuel consumption which has been reduced from 45–50 liters/h to just 20 l/h. He also noted that drilling efficiency has been increased by 50% in good rock conditions and 30% overall.

> "We've only been using Certiq for a few months but I can see it has many advantages.

Benjamin Dubar Plant Director, Lhoist Southern Europe

Matthieu Pasquazzo, Product Manager at Atlas Copco France, says: "In this age of Big Data, we are convinced that Certiq will become an invaluable fleet management tool. Moreover, it is a major advantage for equipment owners like Lhoist to be able to source this technology together with a top class drill rig plus consumables and service all from the same supplier."

In praise of COPROD

The SmartROC C50 rig's COPROD drilling system gives the same hole quality as DTH (Down-the-Hole) drilling but with faster rock penetration and lower fuel consumption. The rig is equipped with a COP 3060 hammer and 115 mm-diameter Secoroc bit. The COPROD tubes are 3.6 m long and 102 mm in diameter, with eight tubes in the carousel and one on the rig, commonly known as an 8+1 configuration.

At the Chaux de Provence quarry, »

THE SMART PERFORMER

The SmartROC C50 with the COPROD system as well as built-in hardware for Certiq, provides a high precision drilling package for Lhoist at the Chaux de Provence quarry.

The COPROD system of impact rods inside drill tubes gives a drill string that combines the hole straightness of DTH with the speed of tophammer drilling. Since the drill rods transmit rotation force only while the drill tubes transmit rotational torque and flushing, stress to the threads is minimal. This, in turn, eliminates the normal effects of impact forces through the threaded joints.

In the Chaux de Provence quarry, the rig operates from 06.00–13.30 daily (including a 30 minute lunchbreak). With a 223 lit/sec onboard compressor operating at 12 bar, the rig handles hole diameters of 90–140 mm to a depth of 32 m. Fitted with the COP 3060 hydraulic rock drill, the rig can be used with COPROD CR76, CR89, and CR102 tubes.

The rig is also equipped with an ergonomic, soundproofed air-conditioned cab, dust suppression, and single service point for daily maintenance.

Easy transition: Operator Gabriel Gonzalez at the controls of the SmartROC C50.

the rig drills holes at a 7-degree angle from vertical on 15 m high benches. This requires a 17 m deep hole with 50 cm of subdrill. The pattern is normally 4.0 m x 4.5 m and blasting of 15–20 holes is carried out once or twice a week. It takes 18 minutes to drill each hole compared to 25 minutes with the company's previous DTH machine.

Making the transition

Operator Gabriel Gonzalez was a major influence on the company's choice of the SmartROC C50, and although he has mainly worked with DTH drilling in recent years he says he has had no trouble making the transition to COPROD.

"This is my third drill rig and it is the one that is most compatible with our requirements," he says. "The automatic mode is very efficient. If I'm careful with the first tube and the first hole is done well, the rest can be drilled in automatic mode faster than I can drill them manually."

He uses five of the nine available tubes which gives him up to 18 m. "Previously, we used five meter tubes with DTH, so we only needed four to complete a hole," he continues. "However, the higher drilling speed and fast tube changing function more than compensates for this. I changed the DTH bit after 4 000 meters while the bit I am using now has done 13 000 meters and it still has life in it."

**Footnote: Telematics is a general term for the use of computers, telecommunications, infomatics and the Internet to wirelessly transmit data in real time to a central point.*

ON THE MOVE in the IRON RANGE

Minntac's product: These magnetite iron pellets are shipped via the Great Lakes to steel mills in the Midwestern United States.

Question: What makes a mining company complement an all-electric drill fleet with a diesel-powered drill rig? Answer: Better utilization.

The United State's Mesabi Iron Range is a narrow formation of taconite stretching west to east across northern Minnesota. United States Steel Corporation's Minntac Mine at Mountain Iron, Minnesota, has supported mining activities for more than six decades and is permitted for a further 25 years.

Minntac has 10 electric drill rigs and recently complemented its fleet with a diesel-powered Atlas Copco Pit Viper 351 rotary blasthole drill and this highly mobile rig is making its mark.

Comparing diesel and electric rigs is not as simple as looking at fuel and electricity costs. Mobility, flexibility and downtime are all considerations when gauging the efficiency of a rig.

Matt Luoma, Area Manager of Mine Engineering and Development at Minntac, says both types of rigs drill equally well. Minntac's fleet drills 406 mm blastholes to depths of 20 m – currently believed to be the largest diameter blastholes used by any surface mining operation in the world.

This large dimension is necessary for the big charges needed to blast the rock which has a compressive strength of 138 Mpa at the low end for waste rock, up to 700 Mpa for the hardest magnetite-bearing ore.

Patterns usually average 150 holes but at times can be over 300. Penetration rates here range anywhere from 6 m per operational hour in ore, up to 30 m/h in waste rock.

Joe Froehlingsdorf, Drill and Blast Coordinator at Minntac, explains that while the PV-351 was purchased to increase drilling efficiency in certain situations, he has no reservations about using the diesel-powered rig for routine patterns normally assigned to an electric rig. "One of

Important tool: The powerful breakout table on the Pit Viper 351 enables the large diameter drill pipe to be easily uncoupled.

» the obvious benefits of diesel-powered drilling is in rough terrain, when we're pushing back the pit," he says.

Electric rigs hard to move

The ore body beneath the glacial till of Minntac's 14 km west pit declines to the south at a rate of 7 percent. The mine strips away the glacial till overburden and waste rock at a rate of 1.2 tonnes for every tonne of ore mined. The waste rock consists mainly of slaty and cherty components that contain less than 14 percent magnetite.

Froehlingsdorf pointed out that moving a cable to an adjacent blast pattern can take a couple of hours and if the move requires stripping steel and lowering the mast on the machine it can take at least a day. In addition, if the move requires portable substations or extensive power cable work, setting a drill up may take several days. By way of contrast, the diesel-powered PV-351 simply trams off one pattern to set up on the next where it can start drilling immediately.

Luoma adds that since incorporating the diesel PV-351 into the fleet, labor costs and downtime associated with moving rigs are down 70 percent. "That's mostly due to the efforts that go into clearing the electric drills outside of a blasting perimeter on the day of a blast," he explains. "Labor resources are limited in the mine and moving electric equipment is fairly labor intensive. As a result, an electric drill would have to be moved out of the area hours before the blast, whereas the PV-351 can be moved out much closer to blast time, resulting in increased utilization."

> "On really bad ground I'd take the mast down, but it only takes three to four minutes.
>
> **Joe Schechinger** Drill Rig Operator, Minntec Mine

With a lighter rotary head weighing only 7 257 kg, compared to Minntac's 15 876 kg electric rotary heads, the rig has inherently greater tramming stability. The superior stability is especially noticeable while tramming with the mast raised, its rotary head high over the weighty drill string. When tramming in rough terrain or crossing the pit require the PV-351 to lower its mast, its live-tower capability means no downtime is lost to stripping steel.

Minntac's pellets have a magnetite content of 65%. The mine takes the blasted ore (consisting of 14% to 40% magnetic iron and 3% to 10% concentrate silica) and delivers a blended product to the primary crusher from multiple shovel positions. This blend consistently falls within the required quality range.

In some parts of the mine, magnetite concentrations can be as high as 45%.

The perfect complement: Unlike electric drill rigs, the diesel-powered Atlas Copco Pit Viper 351 provides Minntac Mine with a high level of mobility. This enables the rig to be moved easily and quickly to any part of the pit.

Move costs down, utilization up: From left, Tom Froehlingsdorf, Shift Foreman; Joe Froehlingsdorf, Drill and Blast Coordinator; Matt Luoma, Area Manager of Mine Engineering and Development.

In order to keep pellets within tolerance, the higher recovery iron ore must be blended with ore of lower iron concentration, which might be on the other side of the pit. This is no problem for the PV-351, which can be deployed anywhere in the mine.

Downtime tracking

All unmanned downtime is counted against rig utilization, including drilling delays that are not drill related. Luoma says the PV-351 has an 81% utilization rate while the combined electric and diesel blasthole rig fleet utilization is 73%. "We collect data on everything, track everything," he says. That includes a mix of 13 hydraulic and electric shovels, 50 218-tonne haul trucks, nine electric drill rigs, with one electric rig on standby, and the PV-351.

Records indicate availability for the PV-351 over the 10 months since its arrival to be about 10% higher than the fleet average. Part of the high utilization rate is due to servicing efficiency. Typical preventive maintenance on electric drills requires that the drills have the power on, but blasting activities do not always allow electric cables to remain in the area in case they are damaged. Since the PV-351 does not require any electrical power, it's service schedule can be coordinated with the blasting schedule more readily, effectively making service delay time coincide with blast delay time. "That's another example of its mobility," Luoma said. "Basically, you can service this PV-351 anywhere without having to send out a cable moving crew."

Good bit life despite hard geology

While half the Minntac bit inventory is from a local manufacturer, the rest is all Atlas Copco. The bits have an average life of about 1 000 drillmeters. The vast majority of the pipe is Atlas Copco Teamalloy steel, 340 mm diameter and 10.7 m in length.

When *Mining&Construction* visited the site, the operator was Joe Schechinger. Even as the excavator was touching up the pattern's far corner of freshly stripped waste rock, led the PV-351 precisely over the first marker, mast up and ready, with its wireless remote control.

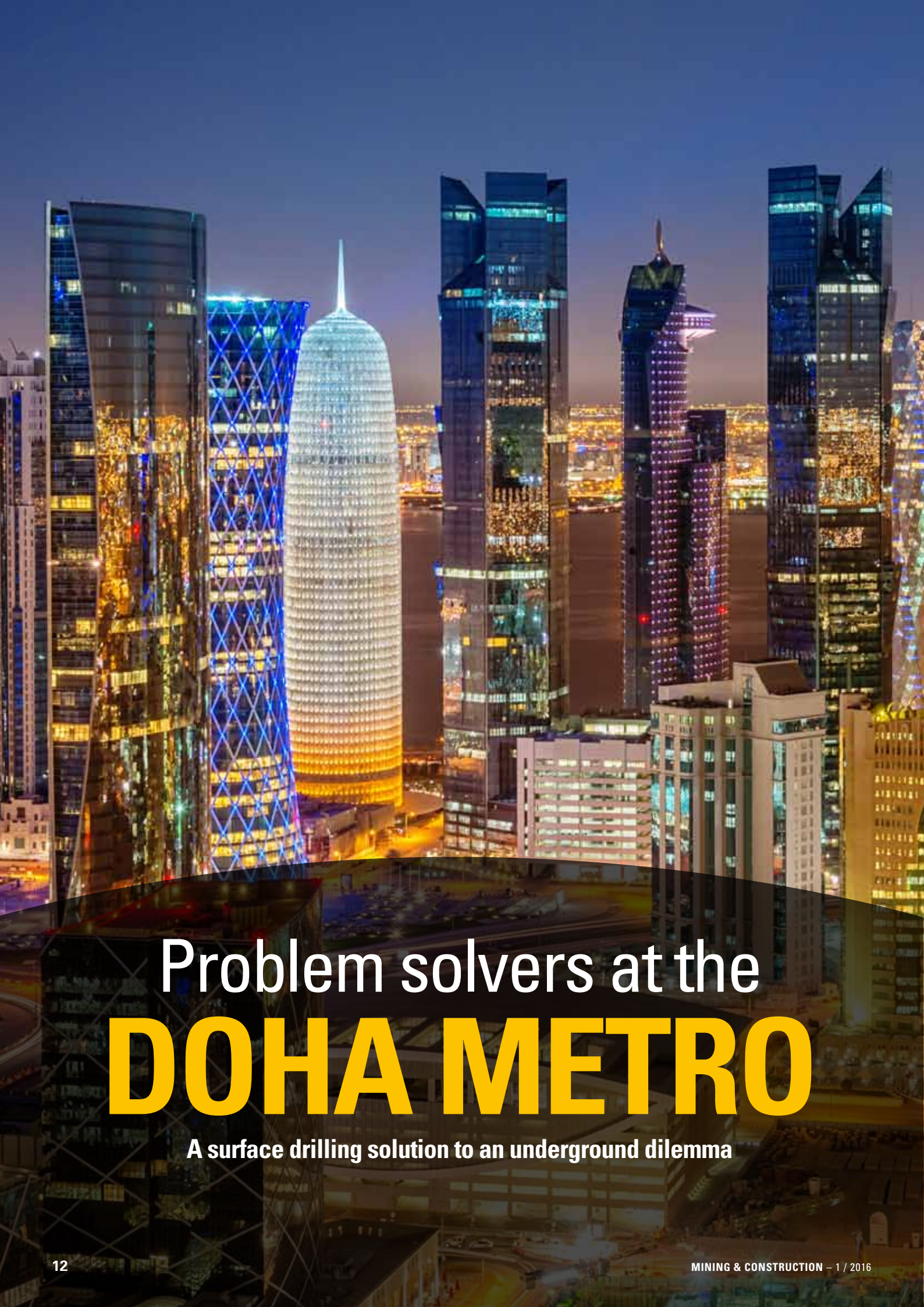
"On really bad, rough ground, I'd lower the mast," he said."It only takes three to four minutes to take it down or raise it up. It's also got a really good break-out wrench."

Leveling the rig, he set up to drill the first 406 mm hole of a 100 hole pattern with a 12 m x 12 m burden and spacing. The operator display showed the pattern he was on, then the auto-drilling parameters. "I can switch to manual or change the settings," he said. "Maybe in this part of the pattern I only need to collar to 3 feet (1 m) and farther on change to 10 feet (3 m). I can change it depending on the conditions."

Minntac's PV-351 is equipped with an Interim Tier 4 engine with 107.6 m³/min, 7.6 bar air package. Volume and pressure are adjustable, though Schechinger often runs it on full. For these holes, he kept about 525 kN of pulldown on the bit rotating at 75 rpm. Single pass drilling of the hole took about 45 minutes.

The cost of moving: Moving an electric cable to a new pattern can take hours and moving a rig at least a day.

Shift foreman Tom Froehlingsdorf said he appreciates the time saving from blast to blast that the PV-351 provides and also gets comments from a variety of people associated with the rig. "Everything I've heard around here about the PV-351 is all positive." Smiling, he added, "The only negative thing I hear is that we don't have two more of them."



Problem solvers at the DOHA METRO

A surface drilling solution to an underground dilemma

Compact and powerful: The Atlas Copco FlexiROC T20 R drilling dewatering holes in the confined space of the Green Line tunnel.

Engineers working on the new super subway now being built in Doha, the capital of Qatar, are using surface drilling technology to solve a common underground dilemma.

The first construction phase of the new Doha Metro is progressing according to plan as three of the four tunnels in the network begin to take shape.

The Green Line, also known as the Education Line, was one of the first projects to get under way. It consists of twin tubes running into Doha from the south before bearing off westwards, through the university district, and on to the Al Rayyan sports stadium.

This is also the line that will transport many thousands of football fans to and from the stadium during the FIFA world Cup in 2022.

Like all of the tunnels in the system, the Green Line has an inner diameter of 6.17 m and a total underground length of 37 km (2 x 18.5 km). It is also being driven at a depth of about 20 m through soft rock – a mix of Simsima limestone, Midra shale and Rus formations.

Progress is on schedule, but the tunnels are constantly subjected to heavy groundwater ingress which presents a major challenge for the engineers, not least at the connection points for the many emergency cross passages all along the alignment.

These passages, which are 10–15 m long and constructed using mini excavators, cannot be connected to the main tunnels until the surrounding ground has been thoroughly dewatered – a task that requires special drilling technology and expertise.

The work is difficult but is being successfully carried out by the project contractor PSH JV, a joint venture of Porr Bau GmbH of Austria, Saudi Binladin Group of Saudi Arabia and Hamad Bin Khalid Contracting (HBK) of Qatar.

Ferenc Lavicska, Plant Manager of the PSH JV, tells M&C: “The focus here is on quality, reliability, safety and sustainability, so when we were looking for a way to tackle the water problem for excavating the cross passages we needed the best solution we could find.”

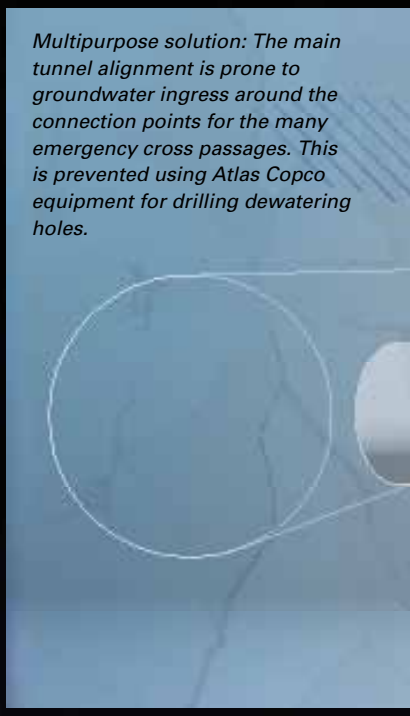
The right stuff

Several different solutions were evaluated before the contractors settled on the one it considered was most likely to succeed – FlexiROC T20 R drill rigs together with the Symmetrix drilling

> “The equipment is very effective and robust which is necessary for this application.”

Ferenc Lavicska Plant Manager, PSH JV

One of the FlexiROC T20 R operating crews together with Atlas Copco specialists during a recent training session in Doha.



Multipurpose solution: The main tunnel alignment is prone to groundwater ingress around the connection points for the many emergency cross passages. This is prevented using Atlas Copco equipment for drilling dewatering holes.

system and round-the-clock technical support, all provided by Atlas Copco.

"During this selection process we had a very good technical discussion with Atlas Copco and they showed us that they could provide a solution that lived up to our demands," says Lavicska. "Since then it has become obvious that we made the right decision."

The FlexiROC T20 R drill rigs, which are mostly designed for use on the surface, proved to be well suited for this underground application. They are compact units designed with a short, customized feed, enabling them to work freely in the very confined space inside the tunnels.

Equipped with the powerful COP 1140 rock drill, which has a high torque rotation motor, they can drill at any angle. They can also be used together with permanent casing tubes (after a simple modification of the drill steel support system) and are exceptionally easy to maintain.

Dewatering the ground

The FlexiROC T20 R rigs start drilling the dewatering holes immediately after the TBM's last gantry has passed the cross passage installation points. The holes are 76 mm in diameter and installed mainly in the tunnel walls to a depth of 12–14 m. Up to 10 holes are completed per day in two, 10 hour shifts.

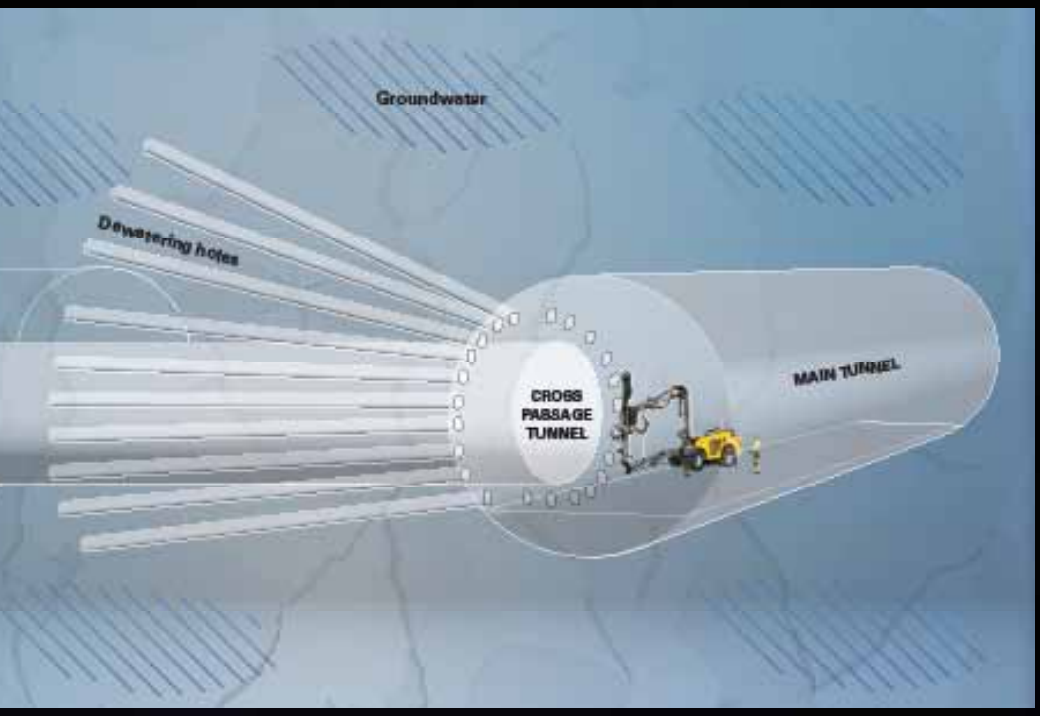
During these essential dewatering operations the rigs have also proved to be very fuel efficient, consuming just 20–25 liters per hour. In addition, all rock drilling tools, including R32 drill rods, shank adapters and drill bits, are proving to be perfectly matched to the application and are long lasting. The service life of the bits, for example, is reported to be 1–1.5 months after continuous use.

Lavicska comments: "The whole arrangement is working out very well. The equipment is not just getting the job done it is also proving to be very robust which is necessary for this application. We are very satisfied with the progress."

Meeting the challenge

Atlas Copco has provided the necessary training for the rig operators at the site, in this case sourcing expertise from several countries in the company's global organization. Specialists from Sweden, Italy and the UK have conducted training sessions at the site on drilling, grouting and maintenance, often in the open air as access to the tunnels is severely restricted.

Besides this, Atlas Copco's local distributor, Oriental Trading Co, is just one hour's drive from the site and is on call 24/7 to make sure the equipment stays up and running.



THE NEW DOHA METRO

The final Doha Metro will consist of some 300 km of tunnels, 18 km of cross passages and up to 100 new stations.

Work began in 2013 and the system will be opened in phases from 2019 onwards, with final completion set for 2026.

There are four main lines – the Green Line, Red Line, Gold Line and Blue Line. The Green, Red and Gold lines are under construction while the Blue Line is still in the planning stage.

All of the tunnels in the system will be 6.17 m in diameter (when lined) and are being constructed at an average depth of 20 m. The primary tunneling method is by tunnel boring machine (TBM).

When complete, the Doha Metro will emerge as an ultra-modern, high-tech system featuring silent, driverless trains and beautifully vaulted, oyster-shaped stations. The system will also be linked with the country's mass transit railway system with the new Msheireb Central Station as the hub.

So far, more than 350 dewatering holes and 600 grouting holes have been completed and all of the planned holes are expected to be in place by August 2016.

Vasanthalu Shivakumar, Sales Manager, Gulf Region, for Atlas Copco, concludes: "The solution to this challenge at the cross passages was the complete package we were able to provide – not just the right equipment but the right training as well as good service support, which is of the utmost importance on this prestigious project."

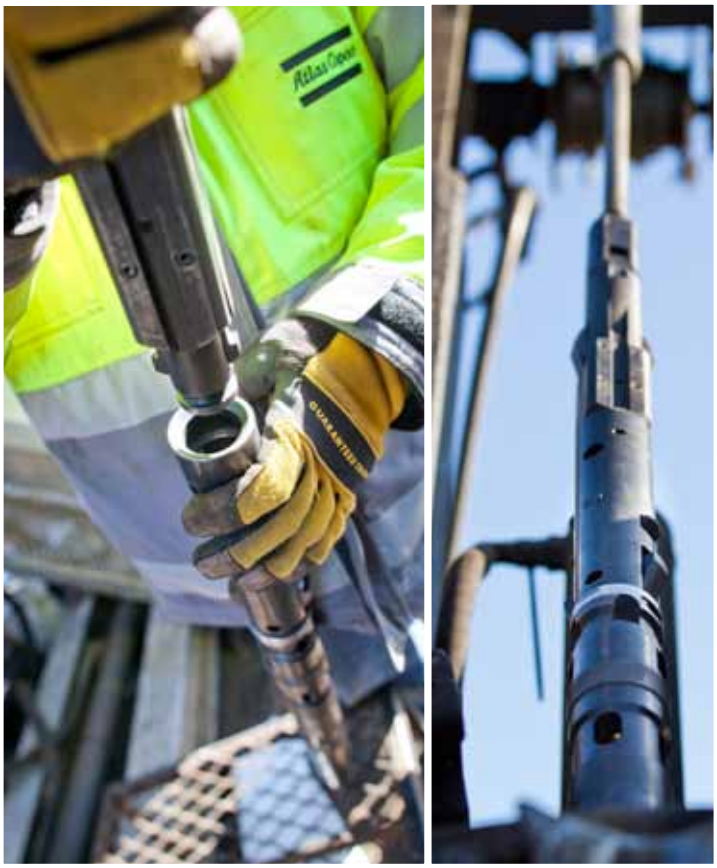
Construction of the Green Line is expected to be completed by 2019.

FOOTNOTE: Other Atlas Copco equipment at work at the Doha Metro includes portable compressors, generators and pneumatic and hydraulic breakers

The Green Line: From the south through the new Msheireb Station in downtown Doha to the Al Rayyan Stadium in the north-west. Also known as the Education Line, as it runs through the Education City university complex, this will be the main means of transport for the many thousands of football fans attending the FIFA World Cup in 2022.

- The Red Line (Coast Line): Running north-south, connecting the towns of Al Khor in the North and Mesaieed in the South, calling at Lusail, West Bay, Mesheireb and the New Doha International Airport (NDIA).
- The Gold Line: Al Rayyan South Industrial Area North, Airport City North.
- The Blue Line: Running in a semi-circle from North to South, from West Bay Central to the Airport City North.

For deeper and faster drilling: The new AZURE bit matrix.



For bringing up the core: The new DiscovOre retrieval tool.

Exploration drilling just got better

Atlas Copco's range of diamond impregnated tools for exploration core drilling has been further improved with a new bit design and core retrieval system.

A new type of bit matrix has been designed for Atlas Copco's premium range of diamond drilling tools, making core drilling easier and more effective than ever.

Called AZURE, the new bit matrix enables contractors to drill both deeper and faster while reducing the time normally spent on changing bits.

Tests show that the AZURE matrix drills exceptionally well through the full range of medium hard to hard rock formations. Furthermore, thanks to the metallurgy and design, the bits cover a wider range of applications compared to their predecessors, making it easier for drillers to choose the right bit for the job.

The cutting ability of the bits allows for a higher penetration rate or a lower weight-on-bit (WOB), whenever the formation demands it. Lower WOB results in less hole deviation, less wear on the equipment in the hole and more precise extraction of the core.

DiscovOre it!

In addition, Atlas Copco has also launched a new core retrieval tool which eliminates many of the common problems found on today's In-The-Hole (ITH) systems.

Called DiscovOre, the tool incorporates an innovative head assembly that eliminates all spring pins. The spearhead pin, which is one of the most common failure points of current head assemblies, has also been eliminated.

Other advantages include robust latches, a leveraged latch design that increases the possibility of releasing an inner tube jammed in the core barrel, and a quick conversion head for all hole orientations.

Atlas Copco is a market leader in the exploration drilling industry and its diamond core drill bits, reaming shells and casing shoes are renowned for their durability, speed and long service life in the toughest drilling conditions.

A premium range for exploration drillers: The Atlas Copco' family of drill bits, reaming shells and casing shoes.

Codelco's choice

How El Teniente is focusing on safety at New Mine Level site

Codelco's El Teniente mine in Chile, one of the world's largest underground copper resources, is looking forward to opening its New Mine Level operation. Not just because it will extend the life of the mine by another 50 years, but also because it will bring safer working conditions for rock support engineers.

> We have achieved a milestone as we are taking people out of hazardous areas.
>
> **Juan Pablo Ruiz-Tagle** Contract Administator, Salfacorp

The trial begins: The Boltec MC in the El Teniente mine.

El Teniente, located 80 km south of Santiago in the Andes mountains, is currently undergoing a massive expansion plan designed to prolong the life of the mine far into the 21st century.

Owned and operated by Codelco, Chile's national copper company, this underground giant is going deeper to reach about two billion tonnes of ore that lie about 350 m below the undercut level of the existing mine.

New Mine Level Project (NML), as the expansion is officially called, is being built at an elevation of 1 800 m above sea level and will employ the sublevel caving technique.

The project involves two parallel tunnels – 9 km in length, 8 m in diameter and connected by 22 cross passages. One of the tunnels is for the entry and exit of personnel, the other for a conveyer belt system that will carry the ore to the surface. In total, the new level will incorporate 98.5 km of tunnels and 3.5 km of shafts.

Safety is paramount

Safety and the working environment have top priority at every stage, not least when it comes to rock reinforcement. During the initial development phase of the project, Codelco determined that the new level site was associated with a more aggressive rock environment and that this would require a different approach to rock reinforcement.

Until then, El Teniente had traditionally used the manual method of bolting whereby bolt holes are drilled using an Atlas Copco Boomer rig with the bolts installed from a basket mounted on an extra boom, among other equipment.

The Boltec rig with the Atlas Copco project team: From left, Alex Ramírez, Supervisor TME rigs, Rodrigo Escanilla, Key Account Manager, Cristian Cifuentes, Product Manager, Omar Allel, Business Line Manager and Marcelo Godoy, Senior Technician.

From the safety of the Boltec MC cab: The operator can clearly see the bolt installation in the rock on his display screen.

Working together with the mining contractor Salfacorp, Geobrugg, the wire mesh provider and Atlas Copco, the NML Project launched a plan to evaluate fully mechanized bolting using the latest Atlas Copco Boltec rigs.

Cristian Cifuentes, Product Manager at Atlas Copco Chilena, says: "Installing grouted bolt and mesh in one mechanized and simultaneous operation reduces the risk to personnel during this important and complex operation. Our challenge was to prove that our Boltec rigs could meet the requirements for the new level, not just for the safety of the rock support engineers, but also in terms of productivity."

Salfacorp, which is developing ventilation drifts, has the mechanized bolting rigs Boltec MC and Boltec EC in its mining fleet and to validate this technology, a three month trial was launched using the Boltec MC.

In addition to one boom for drilling and installing the bolts, this machine also has a boom for mounting wire mesh onto the roofs and walls of tunnels and drifts, making the entire operation truly mechanized.

Atlas Copco provided technical advice and training for the Boltec operators and the trials soon resulted in a number of significant improvements. For example, at the beginning of the trial, the rock support team was installing bolts at the rate of 1.5 per hour. At the end of the period, this had increased to four bolts per hour. Furthermore, no accidents or incidents were reported. The NML Project was convinced, and the company announced that fully mechanized rock reinforcement would be used throughout the new level development and beyond, in areas with higher risk.

Juan Pablo Ruiz-Tagle, Contract Administator at Salfacorp, commented: "The important thing in this project was to achieve a paradigm shift in situations »

> "We know we have to do our best and that means using the best equipment."
>
> **Manuel González Varas** Works Manager, Zublin

All set and ready to bolt: The Boltec MC emerges from the Atlas Copco workshop for transportation to El Teniente.

that require a drastic change of practices. In this respect we have been successful in replacing a manual method with a fully mechanized one. In addition, the cooperation between Codelco and Salfacorp has been a profound success.

"Good communication was one of the reasons we were able to incorporate this multi-disciplinary equipment into production and it has enabled us to achieve a milestone in the sense of taking people out of hazardous areas."

Quality of life

Zublin, another contractor working on developing the interior of the mine, has now also joined the mechanized bolting team with its Boltec MC. Manuel González Varas, Works Manager at Zublin, which has a longstanding, global relationship with Atlas Copco, says: "Our experience with this type of equipment isn't new to us as we already had a Boltec rig in our fleet. What is new is the fully mechanized concept.

"It presents us with the challenge of introducing full mechanization and requires us to have a team that can perform drilling, injection grouting, positioning and mounting mesh, and we can do all this with the Boltec MC.

"In this way, we also improve the quality of life for the operators by enabling them to sit in air conditioned cabins designed for working in hazardous environments.

"We also reduce the number of hours that our employees are exposed to risk. We know that we have to do our best for our client and that means we must use the best equipment on the market. With the Boltec MC we can help to reduce cycle times and improve the productivity."

The same aspirations are expressed by Jorge Pedrals, Project Manager at Codelco for the El Teniente expansion. Stressing the potential dangers to personnel, Pedrals says: "Unlike the existing workings, the New Level Mine environment involves higher pressure. This is due to various factors, but particularly the depth. The fully mechanized rock support solution allows us to minimize the exposure of people to those areas where the risks are highest."

He adds he is certain that fully mechanized bolting is the way of the future. "At Codelco we believe this innovation is here to stay. It is the best way to minimize the risks, at the same time as you maximize the speed of the operation with modern equipment and operator cabins specially designed for these conditions."

> "This solution minimizes the exposure of people to areas where the risks are highest.

Jorge Pedrals Project Manager, Codelco.

A MAJOR UNDERTAKING

El Teniente's New Mine Level Project is a major undertaking estimated to cost some USD 3.4 billion. It is designed in such a way that day-to-day operations at the existing mine are not disturbed. It will also be fully automated, with all mining, processing and transport operations controlled from a new corporate building near the city of Rancagua, 50 km from the site.

SAFETY ON THE BENCHES

Radomiro Tomic mine introduces remote control

Remote control makes its debut at the Radomiro Tomic mine.

In Chile, Codelco continues to implement new initiatives in all of its mines to increase the safety of its workers and step up risk control in the mining of its deposits. Another example is the Radomiro Tomic mine which is introducing remote control technology that may revolutionize its operations.

Protecting miners from the dangers of hazardous environments is an increasing global trend and Codelco's Radomiro Tomic mine is a frontrunner.

In an ongoing effort to make life safer for its miners in this open pit copper operation, RT, as the mine is known, has invested in remote controlled bench drilling equipment.

The mine recently purchased a fleet of five Atlas Copco SmartROC D65 drill rigs together with a BenchREMOTE unit, making it the first in Latin America to introduce remote-controlled benching.

The decision is seen as a milestone for both RT as well as Codelco, reaffirming the group's strategy to apply new technologies to achieve safer, more productive processes.

Located at 3 000 m above sea level in the Atacama desert, some 250 km northeast of Antofagasta and 40 km north of Calama, Radomiro Tomic produces copper cathodes at the rate of around 330 000 tonnes per year.

With the new drill rigs in place, complemented by the BenchREMOTE unit, the mine is now evaluating whether the system can completely replace its traditional benching operations.

> BenchREMOTE helps us remove the final barrier to preventing accidents.

Claudia Domínguez Manager, Occupational Safety and Health, RT.

Claudia Domínguez, Manager, Occupational Safety and Health at RT, points out that the mine has worked hard in recent years to improve safety awareness.

"We impress on all our employees to make the right decision and stop their activities if they encounter risks that are beyond our control such as sudden rockfalls," she says. "In this respect, BenchREMOTE helps us remove the final barrier to preventing accidents as it totally eliminates the risk.

"There have been a number of serious accidents in Chile so this technology from Atlas Copco is most welcome. As it will improve our working conditions it will be highly appreciated by those who do the work."

Mine Manager Raúl Galán agrees, adding that switching from conventional bench drilling to remote control with the SmartROC D65 is a good strategic fit.

"We have a plan that rests on four pillars – safety, innovation, performance and operational excellence," he explains. "The technology is a perfect fit because it is a computerized, high productivity system that also incorporates a high level of protection for our operators. This gives peace of mind."

Moreover, he says the introduction of remote control drilling is in keeping with the times. "The mining industry has changed. We are going through a new cycle of lower copper prices and that means we have to adapt quickly to meet the challenges and stay competitive.

"This equipment helps us to do that. It is more cost effective and allows up to three drill rigs to be controlled from a distance at the same time, which means we get higher productivity as well."

Testing under way

The mine is currently in the process of testing and evaluating the system, but the management is confident it will live up to expectations. If all goes well, the new drill rigs may even be used in fully automatic mode between shifts and during meal breaks, further increasing productivity.

Times are changing: Left, the SmartROC D65 drills by itself while the operator (right) controls all functions from a safe distance.

Compared with its previous fleet, including the Atlas Copco ROC L8, the mine is also aiming for improved availability.

Danilo Díaz, Senior Engineer, Mine Management at Radomiro Tomic, says: "Compared with our ROC L8, we are expecting to see a reduction in the number of incidents as well as longer life and improved performance of the equipment, components and parts. We also expect increased availability, lower annual maintenance costs and ongoing support and training for our operators and maintenance personnel."

Danilo Díaz, Senior Engineer, Mine Management, Radomiro Tomic.

The mine fully expects its operators to embrace the new technology and quickly get used to working inside the BenchREMOTE vehicle at a distance from the drilling patterns on the benches. The rigs will be working in different sections of the pit. The operators will work in pairs and Díaz says he wants as many operators as possible to take turns to obtain broadest possible feedback on operational and maintenance issues.

> "We can control up to three drill rigs at the same time, which means higher productivity."
>
> **Raúl Galán** Mine Manager, RT.

Training the teams

Technical assistance and training are provided on site by Atlas Copco's Boris Cancino and Boris Albornoz.

Some RT operators participated in a two-week training course at the Atlas Copco plant in Sweden as early as in 2014. In September 2015, a three-week course was held during commissioning of the BenchREMOTE system and further sessions were conducted in March this year, mainly focused on training two-man crews.

Operator Luis Vyhmeister Silva was one of the first to use the new equipment. "It takes a bit of getting used to but overall it's all good. One of the strangest things is that there is no noise compared to being inside the rig!

"The controls are more or less the same as in the rig with a few additional ones for zooming the camera so the difference is very small. I think it is a comfortable workplace and of course it is totally safe which for us is the biggest advantage of all."

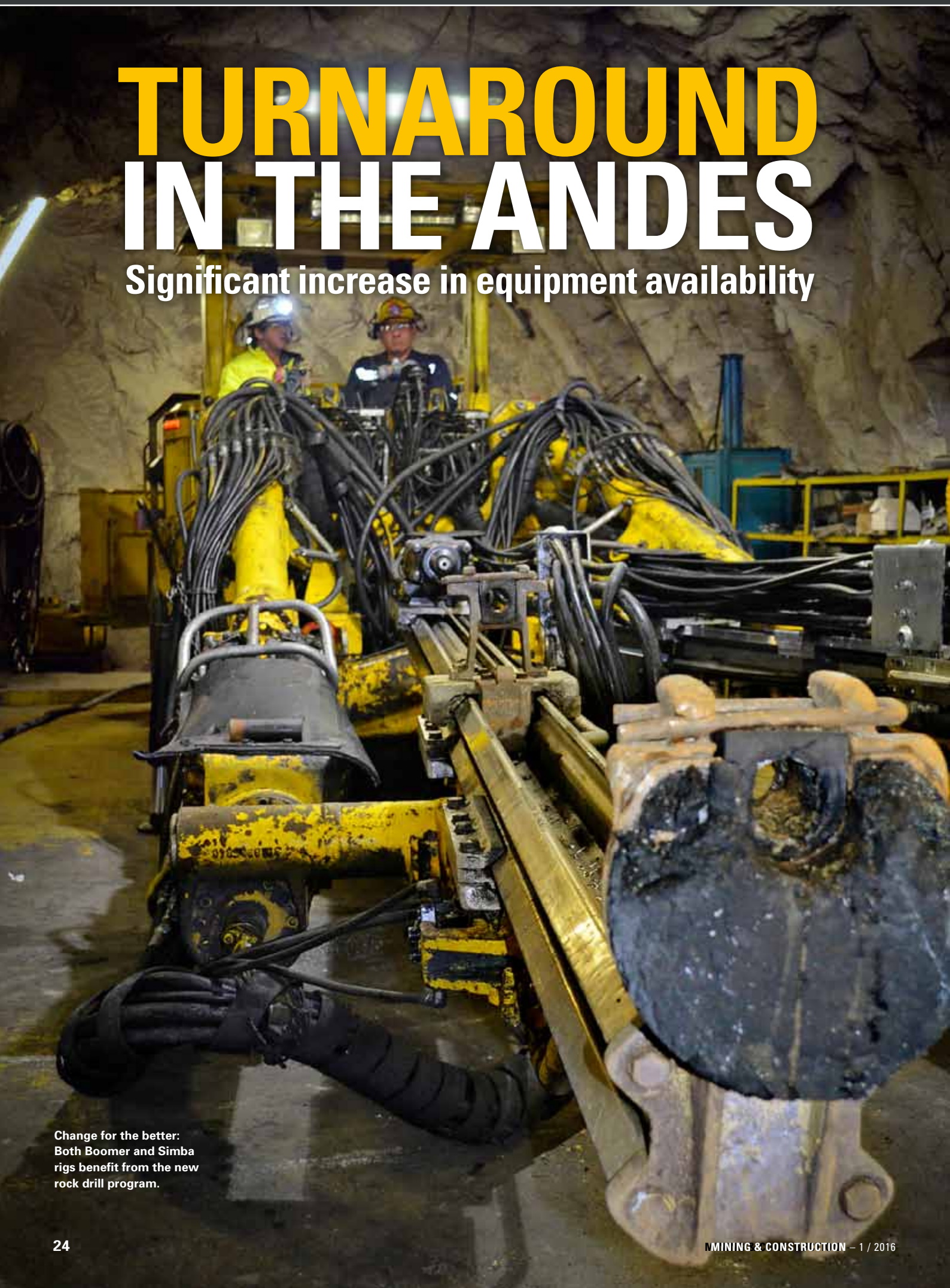
Vidal Martín, Business Line Manager for Atlas Copco in Chile comments: "The technical solution we have provided to RT, which prevents operators from being exposed to risks in hazardous areas and increases productivity, is a key concept in meeting the new challenges that face the mining industry. And it is also very important for RT to be part of this trend."

Atlas Copco Product Manager Francisco Campos, concludes: "BenchREMOTE will revolutionize surface drilling. It is the solution to the problems the industry faces today and enables more mining to be carried out. Proof of this is that we are now implementing this technology at MEL and Minera Candelaria mines as well, with the same level of satisfaction shown by Radomiro Tomic.

Getting used to a new life: Training under way with Atlas Copco inside the specially designed, mobile BenchREMOTE station.

TURNAROUND IN THE ANDES

Significant increase in equipment availability



Change for the better: Both Boomer and Simba rigs benefit from the new rock drill program.

Focus on availabilty: An exchange program for rock drills turned the tide.

When Chile's El Sauce copper mine launched an investigation into the reasons for its declining productivity, the low availability of its drilling equipment was identified as a key factor. What came next became as industry "first".

The El Sauce mine in Chile, owned by the Las Cenizas Mining Group, is believed to be the first company in the mining industry to renew its entire fleet of rock drills as the pathway to a more profitable future.

Located about 170 km north of Santiago, the capital, El Sauce had been suffering for some time from declining productivity, and in mid-2014 an investigation was launched to indentify the cause.

After several months, investigators announced they had found the source of the problem; excessive downtime of production drilling equipment due to insufficient service and maintenance of rock drills.

As a result, a plan was launched to optimize rock drill availability with the support of experts from Atlas Copco – a cooperation that subsequently led to the renewal of all rock drills and hoses.

Exchange program

Atlas Copco repurchased the complete range of existing rock drills (a total of 27) and then replaced them with 12 new ones. These comprised four COP 1435 and eight COP 1838HD+ models.

In addition, Atlas Copco provided technical assistance with fitting the new drills in the underground workshops and with optimizing their performance at the various drilling sites.

Besides this exchange program, the team found that the under-performing rock drills were also affected by the reliability and availability of the fleet's hydraulic hoses which were being changed too often, adding even more to the cost of maintenance. As a result, all the hoses were also upgraded.

These initiatives proved to be the catalyst for a dramatic improvement. Prior to 2014, the availability rating for drilling equipment was 60%. Today, it is 90%.

Raul Fara Engber, Head of Maintenance at El Sauce, says the benefits are easy to see in terms of productivity.

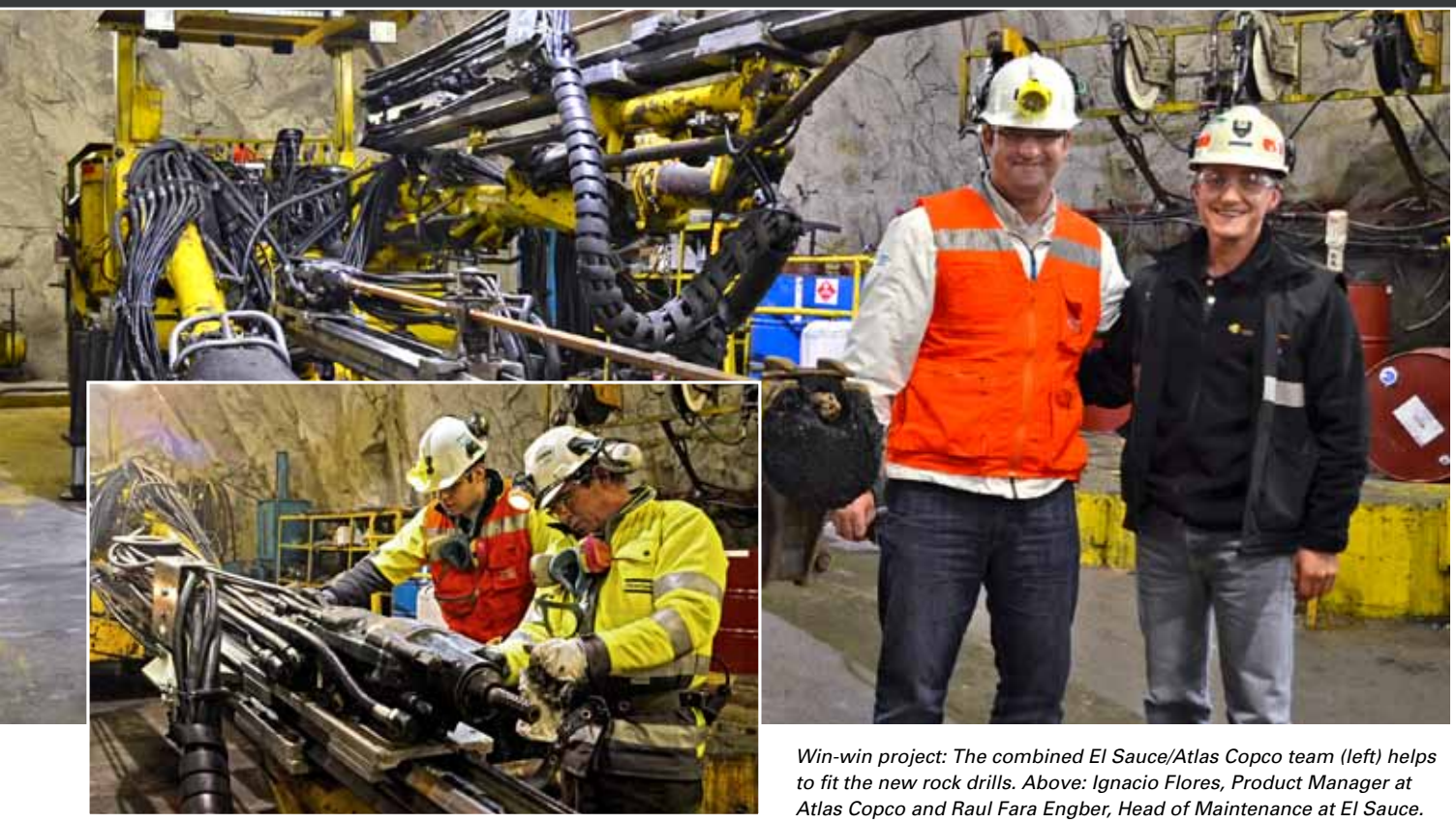
"Previously, it took a crew of skilled drillers four minutes to drill 48 holes," he says. "Today, with the new rock drills, the same crew does the same number of holes in two and a half minutes. This means we are now drilling a face in about two and half hours, which is fantastic."

Replacing the rock drill stock also revealed a surprising bonus. Tests conducted with the COP 1838HD+ showed that these models are multipurpose despite being designed for face drilling. Mounted on the fleet's Simba rigs, they could be used for long hole ring drilling with equal efficiency and zero failures.

It was also found that the new COP 1435 was sufficiently powerful and »

> "We are now drilling a face in about two and half hours, which is fantastic."

Raul Fara Engber Mechanical Engineer and Head of Maintenance, El Sauce



Win-win project: The combined El Sauce/Atlas Copco team (left) helps to fit the new rock drills. Above: Ignacio Flores, Product Manager at Atlas Copco and Raul Fara Engber, Head of Maintenance at El Sauce.

robust to install 2.5 m long rock bolts, a task that could not be achieved before the renewal.

According to Ignacio Flores, Product Manager for Mining and Rock Excavation Technical Service at Atlas Copco, the upgrade project and resulting turnaround at El Sauce is a landmark in the industry. "Such a comprehensive renewal project initiated by the Las Cenizas Mining Group is unprecedented," he says. "To the best of our knowledge it has never been done before – and the results speak for themselves."

Landmark project

The upgrade project at El Sauce began in 2013 with the creation of a new department for Mechanical Planning. The mine management instructed the new department to come up with alternative ways to reduce costs and improve productivity.

In previous years, the mine had budgeted for a maximum of two rock drill replacements per year for a fleet of 10 production drill rigs – four Simba long hole ring drilling rigs and six Boomer face drilling rigs, all from Atlas Copco.

Head of Maintenance, Raul Fara Engber, explains: "Due to this restriction we had accumulated many old and over-drilled units, and since these did not comply with recommended operating hours between service intervals, our consumption of spare parts was much too high and breakdowns and repairs were too frequent. As a result, our productivity remained low and our maintenance costs were too high."

A large portion of these costs, he points out, went to replacing the hoses. "We are talking about more than 200 hydraulic hoses, so with a reliability factor of less than 70 percent it was a significant part of the problem."

Fara adds that he made a bet that the COP 1838HD+ rock drill could increase the availability factor from 65 to 90 percent – and that's exactly what happened. It also enabled the mine to increase the replacement cycles for hoses as failures were no longer a problem.

Financial viability

In agreeing to exchange the rock drill fleet, the mine had one stipulation – that the investment could be regained within 60 months, and here Fara emphasized the strong support provided by Atlas Copco in establishing the plan's financial viability.

"Atlas Copco helped us present the project to our management by demonstrating that this expenditure would be reduced over time, while the benefits would be felt immediately. That's why I say that it was not the Atlas Copco brand that was so important to our success, but the Atlas Copco people, as they were highly motivated to work with as project partners and saw it as a win-win for both parties."

The work does not end here. Together with Atlas Copco, information on the service life cycles of the equipment is being gathered continuously, not just for drilling equipment but also involving Scooptram loaders, with a view to introducing further improvements.

PLUS POINTS OF COP 1838HD+

The COP 1838HD+ series is Atlas Copco's new range of COP 1800 rock drills, developed for heavy-duty, high-speed face drilling and production. Its high durability and reliability enables previous recommended service intervals to be increased by 50%.

Features include an efficient hydraulic dampening system with improved adjustment settings, a new driver, new front guide and improved seal design.

This translates into a lower operation cost as well as increased availability and safety as less maintenance is required. It is also more environmentally friendly as it requires fewer spare parts or repairs.

SmartROC D60 leading the class

Greater intelligence, bigger muscles. The new SmartROC D60 is the ultimate workhorse for tough drilling conditions.

Reaping the benefits of modern technology is a sure way of making drilling easier and safer when the going gets tough – and the new SmartROC D60 is a good example.

Designed for drilling 110 –178 mm diameter blastholes in mines and quarries, the SmartROC D60 is packed with new, intelligent features. These include a feed equipped with built-in sensors on the rod handling cylinders and carousel motor, resulting in better rod handling and fewer breakdowns.

Flexibility is also a key strength of the SmartROC D60. Built on a robust platform, it can be used for a wide variety of applications including production drilling, toe-hole-drilling, horizontal drilling and drilling dewatering holes. It is also easier to service as the feed can be positioned horizontally.

The rig's automatic rod handling system has been upgraded so that drill rods are added and extracted automatically when the desired hole depth is reached. In addition, significant fuel savings can be made thanks to automatic control of engine rpm and compressor load.

The Atlas Copco SmartROC D60 onsite: Intelligence and flexibility for the 110–178 mm diameter hole range.

Powerbit – more drillmeters before regrinding

A new range of drill bits that gives significantly more meters before the first regrind has been launched after rigorous worldwide tests.

The Secoroc Powerbit range from Atlas Copco features a stronger steel body which reduces the need for regrinding, prolongs the service life of the bit and reduces the risk of "popouts" (loosening of the buttons closest to the rock face).

Furthermore, the shape of the buttons on some of the bits in the range have been changed from the semiballistic type to the Trubbnos type. Trubbnos buttons have more tungsten carbide than conventional buttons which also gives better life length and fewer grinding intervals. They also form a larger button area against the rock which improves penetration.

Powerbit is designed for surface drilling in all rock formations in benching in open pit mines as well as production drilling underground.

▶ Read how the new Secoroc Powerbit scored in world tests: P 37

A good bit stronger and more productive: The new Secoroc Powerbit from Atlas Copco.

Bigger is better: These 60 tonne Minetruck MT6020 trucks have increased both capacity and productivity in the haulage operations at Aljustrel mine.

Portugal's Aljustrel copper/zinc mine is back in business and on the road to becoming a world class producer. A strategy to successively increase the capacity and efficiency of the haulage fleet is proving to be a key factor in the mine's new-found success.

TRUCKING to the FUTURE

After doubling its production from 1.2 Mt in 2012 to 2.4 Mt in 2015, the Aljustrel copper/zinc mine appears to be well on the road to a brighter future.

Once closed due to the global economic downturn, the mine has clearly been given a new lease of life by the current owners, Almina Aljustrel, and a new management strategy.

One of the reasons for the recent production increase was a strong focus on the efficiency of the haulage operation coupled with a decision to move up from 40 tonne trucks to 60 tonners, starting in 2015 with four Atlas Copco Minetruck MT6020 vehicles.

These trucks, which haul ore from the stopes to underground crusher stations, have not only helped to increase capacity but also to reduce the traffic congestion on the ramps.

The experience has now led to the purchase of three more Minetruck MT6020 trucks, completing the fleet that will underpin Aljustrel's future development.

Increased efficiency

Joaquim Barreiros, Production Manager at EPDM, the owner's sister company in charge of equipment and maintenance, explains the importance of the haulage strategy to production planning.

"Our objective is to reduce the overall size of the fleet by increasing the capacity of the individual trucks,

while at the same time enhancing our production by getting more round trips per shift," he says.

"The Minetruck MT6020 is well suited for this purpose. They are larger and faster and that will enable us to successively phase out our 40 tonners."

There are two main orebodies at the site, Moinho and Feitais, linked by a 4 km long conveyor tunnel. Both sections are in production using the bench-and-fill method with Atlas Copco Boomer and Simba drill rigs.

The Boomer rigs are used for access roadways, 5 m x 5 m from the main ramp, while the Simba rigs are used for longhole production drilling.

Formidable fleet

The truck fleet is currently comprised of nine 40 tonne dump trucks including two Minetruck MT42, and seven Minetruck MT6020, 60 tonners.

At Feitais, production is currently concentrated at the 530 m level and at Moinho on the 420 m and 440 m levels.

In the Feitais section, the trucks haul their loads on a 5 700 m long spiral ramp to the primary crusher at the 190 m level where it is fed onto a conveyor. The ramp is 6 m x 5 m and has a gradient of 12%.

At Moinho, ore is removed from the stopes by a fleet of LHDs, including Atlas Copco Scooptram ST14 loaders, and loaded into trucks for delivery to the primary crusher – a round trip

> The MT6020 is well suited to our needs. They are bigger and faster, allowing us to phase out the 40 tonners.

Joaquim Barreiros Production Manager, EPDM at Aljustrel.

of more than 4 km. From there it is skip-hoisted to the 100 m level where it joins the Feitais ore on the conveyor to the surface and onwards to the concentrator.

The introduction of the MT6020 was a logical progression because despite its 50 percent higher load capacity, it fits into the standard 5 m x 5 m production galleries and achieves better round trip times.

For example, on the 12% grades between the stope and crusher, the truck uses fourth gear under full load, reducing the round trip time to 40 minutes and with a fuel consumption of just 37 lit/h.

Making the transition

Nuno Felix, EPDM's Director of Maintenance, says he is very happy with the Atlas Copco approach to training, which ensures a continuous supply of specialist drivers for his increasing fleet of Minetruck MT6020 vehicles.

In addition, transitioning from the 40 tonners to the new 60 tonners has made the drivers individually more productive.

For example, Marcelino Bombico and Jorge Cruz work nine hour shifts per day and during a standard shift they complete up to 10 round trips.

Speaking shortly after testing a new MT6020, Bombico told M&C: "When compared to the other machines I have driven, and this includes every truck in this mine, the Minetruck MT6020 is faster, more comfortable and very stable."

Cruz agrees and also emphasizes the serviceability. "We start the shift by going through the service checklist – oil levels, radiator liquid, lubrication pump, and the general condition of the vehicle," he says. "This is essential because if any damage has occurred during the previous shift it needs to be identified and recorded as soon as possible. All of this is simpler on the MT6020 because the maintenance points are so well placed."

Slotting the MT6020 into daily operation on the other hand is not that simple as factors such as vehicle congestion, loading rates, round trip distances and waiting times all have to be considered.

Felix explains: "When you introduce a machine like the MT6020, which is not only faster but also has a 50 percent increase in capacity, you can't really be precise about its effect. You know it is going to be good, but if you are not careful about job allocation, you will find that the speed variation among different models causes delays.

"We want to see the effect of the MT6020 used together over a period of time so that we can establish the rate at which the older machines can be taken off production. That's why we are fast tracking the latest additions into production, and why the driver training programme is so vital."

New service facility

As part of Aljustrel's future plans, its equipment maintenance facility on the surface is being expanded with the addition of a major new service and repair facility. Basic servicing and running repairs will continue to be undertaken at the two underground workshops, one at the 190 m level in Feitais and one at the 335 m level in Moinho.

However, while EPDM has more than 50 maintenance technicians of its own, it has a total service agreement with Atlas Copco for its Scooptram loaders and Minetruck trucks. The trucks and loaders are serviced every 250 operating hours with an overhaul after 10 000 hours. Atlas Copco's service technicians also service the Boomer and Simba rigs.

These arrangements and the introduction of the Minetruck MT6020 are essential components in the effort to make Aljustrel's "comeback" both profitable and sustainable.

Increasing capacity step by step: Joaquim Barreiros, Production Manager at EPDM (right) with Rui Perreira, Product Specialist, Atlas Copco Portugal.

Rapid training vital: Nuno Felix, Director of Maintenance, EPDM.

Part of the fleet: The Atlas Copco Boomer 128, used in the construction of access roadways from the main ramp, during service and maintenance in the Aljustrel workshop.

NEW LEASE OF LIFE

The Aljustrel mine, located in the western section of the Iberian pyrite belt, just north of the Algarve, has a new lease of life.

Fluctuating prices for both copper and zinc over the last 20 years led to an "on-off" situation, slowing down development and production, and resulting in long periods in care and maintenance. This, in turn, led to a loss of skills and a pronounced recession in the mining dependent town of Aljustrel.

With a mining lease of 18 sq km, the mine was acquired and reopened by its current owners in 2009.

In 2013, proven reserves stood at 12 million tonnes at Feitais with a copper grade of 1.98% and 6.5 million tonnes at Moinho, grading 1.74%. In the same year, Aljustrel produced 1.2 million tonnes of ore.

Nearly 700 people are now employed at the mine of which up to 300 are engaged in underground production.

MINETRUCK MT6020

The Atlas Copco Minetruck MT6020 is a fast, 60-tonne capacity articulated underground truck with an ergonomically designed operator's compartment for high productivity operation in demanading mines. Based on the successful MT5010, it offers the same ramp speed, even when carrying the extra 10 tonne payload. The truck's dimensions of 3.44 m wide x 2.845 m high are well suited to the conditions at Aljustrel.

The truck is powered by a Cummins QSK19-C760 Tier 1/Stage 1A six-cylinder diesel engine through a unique powertrain featuring six forward and two reverse gears, and the 844 liter fuel tank gives full shift operating capability.

10 l/h x 40 h/week	**400 l/wk**
50 working weeks/year	**20 000 liters**
Reduction over 5 years	**100 000 liters**
Average fuel price	**USD 1**
Total Saving over 5 years	**USD 100 000**

Fig 1

Significant progess has been made in recent years to improve the fuel efficiency of our surface mining and quarrying equipment. This has resulted in a range of high performance rigs that today reduce fuel costs by as much as 50 per cent.

FUEL EFFICIENCY

– and how to get the best results in the industry

By Mats Birkestål, Global Product Manager, Atlas Copco Surface and Exploration Drilling Division

Technology in the surface drilling industry has made quantum leaps forward over the past few years. It has never been easier to drill blastholes in open pit mines and quarries.

These days, our "smart" drill rigs, find their own way to the hole and then proceed to drill it to the required depth and angle automatically.

But no-one was quite prepared for the progress Atlas Copco has made in reducing the amount of diesel fuel that these machines consume every day.

About five years ago, we took the initiative to see what could be done in this area and our research led to a completely new design platform that focused on efficiency, high utilization and increased fuel efficiency.

Today our rigs are setting records for outstanding fuel consumption around the globe. And this, in turn, is reducing our customers' operating costs, in some cases by as much as 50 per cent.

The simple calculation above (Fig 1) clearly illustrates just how important these savings can be for equipment owners and managers. It shows what happens if fuel consumption is cut by just 10 liters per hour.

Significant savings for all

For many contractors with a single drill rig, a potential saving of USD 100 000 over five years is a significant saving. For owners with a fleet of, say, five rigs, the corresponding saving is USD 500 000, and for those with 10 rigs, the saving will be in the region of USD 1 million.

So what is it that makes these machines so fuel-efficient? Basically, it lies in the way they utilize power and energy. The SmartROC, for instance, consumes the least amount of fuel for its size and type – 16 l/h on average, which is the lowest fuel consumption per meter in the industry. This is thanks to a computer controlled engine that is optimized to always use the least amount of fuel whatever function is being carried out. The engine's rpm constantly rises and falls, depending on the load. Consequently, this reduces fuel consumption and prolongs the life of the engine.

In addition to this, the rigs' hydraulic systems are designed to only deliver hydraulic oil when it is required, compared to conventional rigs which pump oil constantly, and the hydraulic valves are located closer to where the power is consumed.

As a result, we have reduced the amount of oil that is pumped by 65% and the number of hydraulic hoses by 50%. This too, helps to reduce fuel consumption, and every liter saved means

Keeping fuel costs low has never been easier: With Atlas Copco's "smart" drill rigs, fuel consumption is reduced by up to 30% with optimized engines and hydraulic systems. However, thanks to adjustable functions for hole flushing, dust collection and dust binding with water mist, a further 20% reduction in fuel can be achieved.

we also reduce CO_2 emissions, which has a positive effect on the working environment on the site as well as in the surrounding environment.

The operator's contribution

According to our estimations, 30% of these fuel savings is directly attributable to the rig's new design platform, but that a further 20% can be achieved by the operators. This is because the functions for hole flushing, dust collection and dust binding are now electronically adjustable.

1 HOLE FLUSHING This function has the biggest impact on fuel consumption and is provided by the onboard compressor. Flushing is normally done at maximum air speed, but on SmartROC tophammer rigs the operator can adjust the speed of the flow from 0 to 100%.

As a result, the operator is able to "fine-tune" the supply of air so that no more power is used than is absolutely necessary to flush the cuttings out of the hole. And this means the engine does not have to work harder than it needs to, which, in turn, reduces fuel consumption as well as CO_2 emissions.

2 DUST COLLECTING Another fuel saving innovation is the dust collector system. This, too, has been made adjustable to allow the operator to fine-tune the system. By using just the right amount of suction capacity to collect the dust, depending on the conditions, the load on the engine will be less and fuel consumption will be kept low.

3 DUST BINDING In the same way, the small amount of water that is used to bind the dust, can be fine-tuned according to the density of the dust. This, too, requires less engine power and therefore less fuel.

As he performs these tasks, the operator can easily see the actual fuel consumption on the SmartROC's screen. Our research shows that a relatively unskilled operator can easily achieve fuel savings of up to 30%, but that it is possible for operators to achieve savings in the region of 50%, and, for many companies, that extra 20% represents a significant reduction in running costs per year.

Obviously, not all companies attach the same importance to fuel consumption in their operations. Costs depend largely on local prices. But I am convinced that all companies appreciate that saving on fuel has a positive impact on operating costs, and as a consequence, will impact their "bottom line"over time.

Mats Birkestål is Global Product Manager at Atlas Copco's Surface and Exploration Drilling division with responsibility for tophammer cab drill rigs.

CARETAKERS of the Czech Republic

A new SmartROC T40 from Atlas Copco goes to work: Contractor CB Destrukce's CARE agreement means that it does not have to worry about the availability of the machine.

CB Destrukce of the Czech Republic is one of the country's top ten contractors providing drilling and blasting services for the construction industry – and it's all about CARE.

Czech drilling and blasting specialist CB Destrukce is celebrating its 25th year in the industry this year following a record 2015. Founded in 1991, the company made its name in small scale quarrying, later moving up to large-scale mining of raw materials for the construction of roads, highways, railways and pipelines.

Last year, it recorded a record 300 000 drillmeters – its best performance ever – and has expanded its equipment fleet with two new SmartROC T40 rigs, backed up by an Atlas Copco CARE agreement – a combination that helps the firm to live up to its brand promise of quality and reliability.

M&C asked Jan Šebor, owner of CB Destrukce, why the CARE agreement is so important. "We used to have a service contract with Atlas Copco for the ROC F9C, but at that time it was a full contract," he said. "We wanted to change it for the future, so with new machines we decided on a more flexible service solution and CARE was the best choice."

He continues: "What convinced us was the professional way Atlas Copco takes care of its machines. We used to do the service ourselves, but the results were never as perfect as with Atlas Copco."

> "The biggest fear that all contractors have is that the quarry operation has to stop.

Jan Šebor Owner, CB Destrukce

Making the difference

Since the CARE agreement has been in place the company says there has been no downtime and every job has been carried out on time. "That's what differentiaties us from our competitors," he says.

But the most important aspect for the company is the fixed cost. "Every month we pay a fixed price for the contract and we don't have to worry about any unpredictable failure which might cause a big problem for our customer and for us," Šebor explains. "We calculate this as price per drillmeter and it enables me to plan for the current year as well as for the following year.

"As an owner, it is important for me to know the costs in advance. If I can plan better, I can be more competitive."

Another big advantage, he says, is peace of mind. "We don't have to worry about a rig breaking down in high season, causing huge losses for the customers, and for us. The contract gives me reassurance that the rig is under control, that

Owner Jan Šebor, checks with his operator, Milan Lukeš, that everything is running according to plan.

all preventive maintenance is done at the right time.

"Also, as the contract is directly with the manufacturer, every repair is prescribed with original spare parts which means you can rely on them and don't have to be afraid that something will break down and cost more money."

Šebor makes it clear that previous attempts to save money on parts did not succeed. "We have our own service center with our own technicians and we previously did the service work," he says, "but the quality and reliability did not compare with having a machine under a CARE agreement."

Winning reputation

Šebor says he is convinced that the results achieved thanks to the CARE agreeement has enhanced CB Destrukce's reputation in the market and helped the company to win new contracts.

He continues: "It is not only a case of being reliable. When the machine arrives at the quarry, nobody wants to have to start repairing it, as some of our competitors do.

"The biggest fear for a contractor is that the operation has to stop because that affects productivity. Everything starts with the drilling and if it is not done on time, blasting, loading and everything else has to be postponed.

"So drillers like us are really in the front line. Thanks to new machines and CARE contracts our losses are small, the jobs are carried out as planned and we can keep our promises."

The rise and rise of RigScan

Among the most recent rig owners to embrace RigScan auditing is the Long Mang Ming Co. – the first company in China to use the service.

The audit was carried out on a fleet of seven surface drill rigs leading to a major overhaul by the Atlas Copco service team in Nanjing.

Located in Sichuan Province in south-western China, Long Mang Ming is a surface mining operator and a key Atlas Copco customer.

The company has six FlexiROC D60 drill rigs (previously ROC L8) and one FlexiROC D65 (previously ROC L830), most of which are more than five years old.

When the company contacted Atlas Copco, two of the rigs were out of action and the remaining five, although still in use, were not performing to the best of their ability.

As a result, the company decided to put the entire fleet through a RigScan audit, prior to overhaul and repair work.

The most senior service technicians from Atlas Copco's Customer Center in Nanjing were assigned to perform the audit, supported by the local Atlas Copco distributor.

The audit was carried out between 24 November and 3 December, 2015. This was followed by a meeting with the owners' representatives where the results contained in the final RigScan audit report, generated through the audit, were closely examined.

Long Mang Ming was impressed, particularly by the ability of the RigScan scanning device to inspect hydraulic components and the temperature of moving parts using a thermal imaging camera.

The reports clearly identified the causes of various failures and provided the equipment management team with recommended solutions.

As a result, the necessary spare parts could be ordered and the Atlas Copco service team in Nanjing was commissioned to perform a complete and cost-efficient overhaul of the fleet.

New precision in long hole drilling

Simba S7 proves that it's "on the ball" underground

The Simba S7 demonstrates its outstanding precision by performing "the butterfly" shot. See it in action on Atlas Copco Underground's YouTube.

Atlas Copco has introduced a new version of its Simba S7 long hole drill rig that features extremely high precision for fan drilling in underground mining.

"The Simba S7 concept is based on a combination of our rig control system RCS, integrated angle instrument and the automated software options," says Product Manager Mikael Larslin."This is what makes it possible for the rig to adapt to the rock conditions as well as to drill with such high precision."

The rig's automated functions allow drilling to continue unattended through shift changes and meal breaks, which increases productivity. In addition, it has enhanced safety features such as automatic drill stoppage that prevents potential injuries to personnel and damage to the equipment.

The rig is designed for drilling 51–89 mm parallel holes in small-to-medium sized drifts. It is capable of fan drilling upward and downward with a spacing of up to 5.9 m.

Equipped with a high-performance, tophammer rock drill and boom-mounted drilling unit, the Simba S7 is available worldwide.

Cleaner and safer mining with Scooptram ST7 Battery

Zero emissions: The new Scooptram ST7 Battery.

Mobile equipment in underground mines has traditionally relied on diesel engines and require costly ventilation systems to deal with the exhaust emissions. Not any more, thanks to a new battery driven loader from Atlas Copco.

Scooptram ST7 Battery is Atlas Copco's first battery driven product for the underground mining industry, making life easier, cleaner and safer for miners. Although electric loaders already exist, these units have to be connected to electricity cables which considerably limits their operating range.

As the trend towards deeper mines continues and mining companies seek to gain more control over their operations, the Scooptram ST7 Battery would appear to be the answer to many of the challenges.

These include the ability to control multiple loaders from a safe, remote location, and planning and repeating the perfect production cycle every time.

Lars Senf, Vice President Marketing at Atlas Copco's Underground Rock Excavation division, says: "Loaders and trucks consume about 80 percent of the diesel fuel used underground. Loaders are most often used in dead ends of the mine, which are the most difficult to ventilate.

"To make the greatest impact on the working environment and ventilation costs, it was an obvious choice for us to launch a battery driven loader as our first product of this type."

The initiative to create battery operated equipment has been driven by new battery technology, making it possible to create powerful and productive equipment with zero emissions.

The Scooptram ST7 Battery will be initially introduced in North America and gradually rolled out globally.

WORLD DRILLERS RATE new TOPHAMMER RANGE

Atlas Copco's new range of tophammer drill bits for surface drilling – Secoroc Powerbit – has been put to the test in hard rock conditions at worksites around the world. And the conclusion is …

Following extensive testing in hard rock conditions, drillings contractors are unanimous in their appraisal of Atlas Copco's new Powerbit range of rock drilling tools. M&C reports from three of the top test sites located in the USA, Sweden and Turkey.

Powerbit PIONEERS

USA

WILLIAM A. HAZEL, Inc. of Chantilly, Virginia, is a leading site development contractor that has pursued innovative technologies for more than 50 years.

For example, it was one of the first companies to test cab drill rigs in this region which predominantly favors "stand beside" rigs.

As Atlas Copco prepared to introduce the new Powerbit line of top hammer bits to the market, this family firm agreed to put some of its drill crews at Atlas Copco's disposal to test the new bit at some of its more challenging sites.

These drillers encounter some of the toughest rock in the region while working on housing and infrastructure projects designed to support the growing population of the Washington D.C. area. Featuring bands of hard diabase rock, these sites were ideal proving grounds.

"It reminds me of a retrac bit," said Tom Ashbaugh, Blasting Superintendent. "It has flutes like a retrac, and you can back it out of a hole like a retrac, but when we've run retrac bits here we've had trouble keeping the holes open.

"The Powerbit does a much better job of collaring the holes. It's wider on the bit end and again further up the shaft. You don't see as much deviation from it. Holes stay vertical, straighter, and what I like best, of course, is the gauge which is maintained up the neck."

Gauge retention during bit life is a critical factor in controlling fracture size and overall efficiency of the blast. The boosters used are 70 mm (2 ¾ in) in diameter, leaving only a 0.9 mm (⅜ in) wide annulus in a true 89 mm (3 ½ in) hole. As the gauge wears and the holes narrow, the risk that boosters might 'hang up' and fail to seat at the bottom of the hole increases. Another concern is that smaller holes have less room for emulsion.

"But this bit maintains its gauge throughout its life, yet doesn't restrict flushing," Ashbaugh says. "In fact, it seems to have better flushing in general. So I'd say in diabase rock, it does a much better job than other bits we've used."

The U.S. test team: From left, Craig Mooney, Territory Manager, Atlas Copco; Tom Ashbaugh, Blasting Superintendent and Ricky Clatterbuck, Blasting Assistant Superintendent both of William A Hazel Inc; and John Swift, Branch Manager, Atlas Copco.

The new Secoroc Powerbit is put to the test on construction sites in the Washington D.C. area where ground conditions shift from 275 MPa diabase to much softer formations. The Powerbit came through with flying colors.

Blastholes 4–5 m deep were drilled and about 1 m of soil overburden was left in place as stemming material over the diabase, which is rated with a hardness of 275 MPa (40 000 psi).

To ensure comparable test results, drill rigs from a variety of leading manufacturers were also used, each equipped with an 89 mm Powerbit. Between holes, Atlas Copco field engineers checked the bits for signs of wear.

The bits were not run to failure. Instead, at the first sign of a change, they were pulled, the depth noted and the bit was set aside to be sent to Atlas Copco Secoroc's facility in Sweden for analysis.

The drillers said they believed the

SECOROC POWERBIT DESIGN SETS BIT LIFE RECORDS

The design of the Atlas Copco Powerbit is unusual in that it was not engineered as an improvement on existing designs but as a design and research project from scratch, using input from customers.

The steel grade of the bit body and the button materials have been developed with longevity and high quality in mind.

William A. Hazel was looking for a bit that was comparable in price to its non-Atlas Copco bit, but one that would at least double the average service life in diabase.

The Powerbit's bit life increased by an average of 92% over the company's previous spherical button bit. At times, the Powerbit tripled the productivty, exceeding 365 m (1 200 ft), yet effectively maintained its gauge. There were no bit failures during the test period.

»

Powerbit was generally drilling with the same penetration rate as their current bit but that it was giving 2–3 times more meterage, in some cases more than four times. At the end of the test, Ashbaugh noted that Atlas Copco had left one bit behind. Whether it was an extra bit or one that did not need to be sent for analysis was unclear.

"The drillers found the bit, figured it was a leftover, and thought, 'hey, it's still good, so why not keep drilling with it?' "Ashbaugh said. "The first site they took it to was covered in shot rock. It was pretty gravelly, but the Powerbit did well." And nodding to one end of the site which had been flooded with rainwater, he added, "We can also run this bit in water without any problem."

SWEDEN

BOLIDEN'S GARPENBERG mine in central Sweden is one of the most modern and productive mines in the world. It is also one of the oldest mines in the world dating back to the 13th century.

In 2016, when full capacity is reached, it will yield 2.5 million tonnes of ore per year containing zinc, lead, copper, silver and gold.

About a million tonnes of tailings are pumped to the tailings pond and excess water is filtered through a treatment plant anually. This requires the height of a dam to be raised by one meter every year.

To obtain the material for topping the dam, drilling and blasting is carried out at a nearby quarry. This was a challenging environment for the new Powerbit where the medium hard and very abrasive granite limits the service life of bits to approximately 250 drillmeters.

The Powerbit with its 12 or 12.7 mm Trubbnos buttons, was put to the test by drilling contractor Berg- och Byggteknik AB using an Atlas Copco FlexiROC T40 rig equipped with the COP 1840 rock drill and T45 MF rods.

During the test it was compared with the driller's current 12 mm semi-ballistic button bits – and exceeded all expectations.

Penetration rate proved to be slightly better, but the service life increased by 75%. It delivered more drillmeters before the first regrind, more meters between regrinds, and many more meters drilled before bit discard.

"I get about the same penetration rate with the Powerbit but a lot longer service life", confirmed driller Mikael Waldén.

A key success factor when drilling in this tough ground was the use of Trubbnos grinding wheels. By recreating the shape of the Trubbnos buttons at each regrind, grinding was less frequent and the overall service life of the bit was substantially increased.

Testing the Secoroc Powerbit at the Garpenberg mine showed that penetration rates were roughly the same as before, but that the overall service life length of the bit was substantially increased. Left, driller Mikael Waldén of Berg-och Byggteknik.

Sunset over the Kaymaz goldfields in Turkey following rigorous testing of the new Secoroc Powerbit.

These Atlas Copco SmartROC T35 and FlexiROC T35 rigs were used in the Powerbit test, drilling blast holes 5.5 m in depth. Each rig was equipped with the 102 mm Powerbit T51 with retrac design and spherical HD buttons (right).

TURKEY

THE KAYMAZ GOLD MINE in the Turkish province of Eskisehir, includes the open pits of Damdamca and Topkaya.

Damdamca, two kilometers east of Kaymaz, and Topkaya, just 530 m south of Karakaya, have a combined production of around 15 000 m^3 of ore per day.

Mineralization in this region generally consists of listvenite-type sedimentary rocks and silicified serpentine veins.

This material is abrasive and has a hardness rating of Mohs 7 – a formidable challenge for the drillers and the perfect test site for the new Powerbit.

Stripping and ore production is carried out by the mining contractor Uluova Construction using four Atlas Copco drill rigs – three FlexiROC T35 as well as a SmartROC T35.

On the 10 m high benches, the drill patterns vary between 2.5 m x 2.8 m and 3 m x 2.8 m and the holes are 102 mm in diameter and 5.5 m deep.

The Powerbit was tested in this tough environment for one week and a total of 4 600 m were drilled.

At the end of the period, Özant Demir, Drilling Manager, said the Powerbit was "extremely impressive."

He continues: "Penetration rate and service life is very important for us. According to the test results, we get more drill meters and longer service life and now Powerbit is the best option for our efficient production."

Penetration rate was 80–100 m for one percussion hour and the overall service life of the bit increased by up to 60%. The Powerbit also delivered higher productivity in terms of approximately 50 more drillmeters per shift. Compared to bits the company normally uses, the Powerbit proved to be an all-round winner.

Dimension stone may well be a niche business in the world of quarrying, but it is rapidly cutting its way into the mainsteam. M&C talks to Hakan Aytekin, Regional Business Manager for Atlas Copco in Europe, to find out what makes it so special.

Insight On DIMENSION STONE

Q: ***How would you describe the industry today?***
A: In a nutshell, it is a very important supplier to the construction industry. It produces many different types of stone products, usually cut to specifications and used, for example, as flooring, wall coverings or cladding on the exterior of buildings. But they are also used in many forms in art and design.

Q: ***How big is it, globally?***
A: In 2013 world production was 130 million tonnes with 59% being marble and limestone, 36% granite and 5% other industrial stones such as slate. Except for 2008–2009, the average 10-year growth rate rose by approximately 8% up to 2014. Since the second half of 2014 to the present day there has been a decline in production, mainly due to the decline in construction during this period.

Q: ***What are the most popular materials?***
A: Fashions in colors and stone types change drastically. For example, counter top granite is the best material for floors in airports due its physical characteristics. However, over the last 10 years, marble has been more popular. At the recent Xiamen exhibition in China, which is one of the major trade shows in the DSI industry, the buyers were mainly interested in quartz.

Q: ***What kind of challenges do stone quarries face today?***
A: Generally speaking, safety and the environment are crucial issues in West and North Europe, the US and Canada, but not in most other parts of the world. Nevertheless, Atlas Copco's products always meet the highest safety and environmental standards, even though we may not be obliged to do so by the regulations. That's not the case for the majority of the players in this industry.

Q: ***When did Atlas Copco become a major supplier to the industry?***
A: Firstly, we are very well established in the industry through other products. For example, Secoroc is a big supplier to the granite industry with integral drill steel and tapered rods. Every dimension stone producer has to have compressed air and almost all of them have electrical compressors while many of them have portable compressors as well. In addition, every quarry has one or more hydraulic breakers.

When we acquired Perfora in January 2012, it enabled us to add our first DSI-specific products to the portfolio. Today we are the only global supplier in the market and we are the market leader in our product group.

Q: ***What does the product group consist of?***
A: We supply two types of hydraulic drills – RockBuggy with one feed, and SpeedROC 2F with two feeds. Unlike traditional blast hole drills, these machines drill holes to remove benches and then make blocks out of these benches by splitting.

We also have the well known SpeedCut wire sawing machine. This is designed for DSI production but is also used to open tunnels in urban areas. Instead of drilling and blasting, blind cuts are made in the tunnel face in order to reduce vibrations. SpeedCut has also been used to make cuts of up to 2 000 m^2 for the opening of a new quarry which is unique.

We have two versions of wire saws, SpeedCut 100 and SpeedCut 75. Wire saws can be used in combination with drills in granite production but it is the major production technique in marble production. We produce a semi-hydraulic drill called SpeedROC D30, specifically for drilling holes for the wire saw. What is important in this process is to have a portable drill that can access confined spaces and can drill very close to the surface.

Recently we have also introduced a DSI version of the FlexiROC T15 with Tier 3 for unregulated markets. This rig is intended for construction, but due to the relatively low capital investment and flexibility in niche conditions it is a preferred product for some customers.

Q: ***What is the key to successful stone cutting?***
A: There are three things to consider which make it very different from drill and blast. It is important not to damage the rock, the surfaces have to be as flat as possible and there should be a minimum of material loss. That's why our

Hakan Aytekin, Regional Business Manager, is based in Bagnolo, Italy at the Atlas Copco center for dimension stone equipment innovation and development.

drill rig feeds are mounted on rails. This also helps to speed up positioning and creates holes that are perfectly parallel. We also supply an attachment with two feeds and a rail that can be mounted on an excavator, called Dominator.

Another major difference is that approximately 34 mm is the standard hole size. This is used mainly for granite and some types of marble and limestone.

Q: ***Where is the hub of Atlas Copco's stone cutting expertise?***
A: Atlas Copco's main DSI manufacturing facility is in Bagnolo Piemonte, Italy, about one hour's drive from Torino. We are in the heart of the Italian car industry with many well known car producers such as Fiat, Maserati, Jeep and Alfa Romeo situated close by. It's a relatively small operation which enables us to be flexible and fast in responding to the needs of our customers.

Q: ***What are the latest product developments?***
A: About one and a half years ago we decided to renew our portfolio with the aim to increase reliability even more. To do this, we not only redesigned the products but also used similar components to those used in our products for construction and mining. This commonality not only increases reliability but makes the products easier to service and get quick delivery of parts. This means by the end of this year we will have a completely renewed portfolio to offer the market.

Q: ***How do you see the future for DSI producers?***
A: The industry will continue to grow as long as the construction industry grows. At the same time, the quarries that are still using pneumatic drills and hand-held equipment will move up to hydraulic equipment and this will open up many more opportunities.

This will make them more productive and more efficient – but that's not all. Our innovations along with high reliability will also help the owners to reduce their total cost of ownership and that's the key to success for the whole industry.

Sandy and abrasive rock is a complex challenge for copper miners on Indonesia's remote Wetar Island. The awakening of 'a beast' has taken high performance drilling to the next level.

THE BEAST OF Wetar Island

PowerROC T50 gives mighty performance in tropical Indonesia

Among the thousands of islands that make up Indonesia's tropical archipelago, few tourists find their way to the outlying Wetar Island in the remote parts of Maluku Province.

Surrounded by coral reefs and characterized by mountainous peaks, Wetar Island is home to just 9 000 inhabitants and the only way of reaching it is by boat or landing craft from a handful of mainland ports.

Here, on the north-central coast of the island, mining contractor and equipment rental company PT Madhani Talatah Nusantara has been tasked with developing the resource at the Wetar Copper Project – a copper mine which has a projected 10- year lifespan and a high copper grade of 2.4% Cu.

The Wetar Copper Project is owned by PT Batutua Tembaga Raya, a subsidiary of Finders Resources Limited. In its endeavor to reach new sections of the mine's orebody, a powerful drilling solution capable of handling complex ground conditions was required.

Hard rock, heavy cuttings

The mine's tough geographical structure involves sandy and abrasive rock with a density of up to 4.2 tonnes/m^3. This posed a considerable challenge for the drillers on site, but service reliability of the equipment was also crucial and finding the right tophammer drilling solution with powerful air flushing to extract the cuttings was a priority.

"The first thing to consider was the remote location of this project, which necessitated a drill that would deliver consistent reliability," says Trevor Howie, Madhani's General Manager – Operations.

"We also considered the up-hole velocity needed to extract the heavy drill cuttings and the PowerROC T50 delivered this required velocity. We are pleased with the PowerROC T50 performance and with Atlas Copco's after sales service, confirming we made the right drill selection at Wetar."

Due to the sandy rock conditions, the bench height was set at 6 m with a drilling burden of 3.5 m and a hole diameter of 102 mm. To tackle this challenge, two PowerROC T50 drill rigs equipped with COP 3060 rock drills and T-Wiz 60 drill rods were put to work.

> "The PowerROC T50 is just like a beast, powerful but easy to understand.

Taufik Pribadi, Project Manager, PT Madhani Talatah Nusantara.

Grade control performance

According to Nick Holthouse, Earthworks Manager at PT Batutua Tembaga Raya, the results from running the drill rigs for 11-hour, 7-day shifts were more than satisfactory, especially in the mine's grade control program.

"The rigs have performed well in the highly abrasive and dense ore types. **The ability of these rigs to cleanly lift the**

heavy cuttings produced while drilling is paramount in achieving a good quality sample, which is essential to the operation's grade control program."

Using the PowerROC T50, 17.5 m were drilled per hour and rig with an average fuel consumption of 21.7 liters per hour, which enabled high productivity and efficiency.

Taufik Pribadi, Project Manager, PT Madhani, says: "During startup, an Atlas Copco service engineer provided us with training on regular troubleshooting, guided us on how to view the hydraulics and electric diagram and explained the structures and functions of the PowerROC T50.

"We now have the knowledge to perform troubleshooting, but if there is something that is beyond our scope, we can call the service team and get a quick response. "Fortunately, we haven't met with any problems so far. The PowerROC T50 with its straightforward system is very stable."

The drill rigs achieved a net penetration rate of up to 3 m/min. Hole cleanliness was guaranteed thanks to the high flushing air speed, which resulted in straight holes with no deviation and a minimized risk of bit jamming.

Having operated the PowerROC T50 during startup, Drilling Trainer Tidar Sumarsomo emphasizes the importance of clarity and simplicity when it comes to rig controls.

"The PowerROC T50 is easy to operate. I can start drilling easily after a short instruction and the drilling is is really fast." he says. "Most of all, I don't need to worry about complicated structures that I don't understand. All mechanical and electrical connections are marked and labelled clearly.

"It's just like a beast," he concludes. "Powerful but easy to understand." ⊙

Proud performers: From left, Tidar Sumarsono, Trainer, Fery Ainul Wahib, Mechanic, and Aji Purwanto, Atlas CopcoTechnician, with the PowerROC T50.

Meeting the demand for wells

Modern surface drilling technology is driving the increasing demand for geothermal and water wells, and well drilling specialist Säffle Brunnsborrning is among the growing number of small entrepreneurs who are taking full advantage of the trend.

Some 20 000 geothermal wells are drilled in Sweden each year and many more worldwide to meet the growing demand for low cost energy.

The rural provinces of Dalsland and Värmland are typical cases where many family homes rely on their own wells for energy as well as drinking water.

To perform this highly specialized task, private individuals and building contractors call in professionals like Säffle Brunnsborrning, one of the region's leading geothermal and water well providers.

Säffle Brunnsborrning was founded in 1976. Managing Director Daniel Carlsson took over the leadership in 2010 and has gradually seen it grow, along with demand. Today, about 75% of the holes the company drills each year are for geothermal purposes and 25% are for water.

One of the key factors behind Säffle's success is the equipment package it uses, supplied by Atlas Copco, and the company recently invested in its second equipment set – a WellDrill 3062CR drill rig and a new compressor, the DrillAir Y35.

"This has doubled our capacity," says Carlsson. "With our two sets we are now delivering up to 13 bore holes per week."

Easy choice

Deciding what supplier to use was an easy choice, continues Carlsson."Operational reliability is extremely important for our business, and I can honestly say I don't even remember the last time we had an equipment failure," he says.

"Furthermore, the equipment is easy to handle and move between jobs, and that's important for our working environment."

The company performs quick maintenance checks on the machines about once a week and also has a service agreement with Atlas Copco.

"Our customers include both private individuals, as well as building contractors with larger projects," he says, "and satisfied customers is what leads to new assignments for us."

Marcus Österberg, Atlas Copco's representative in the nearby town of Jonsered, maintains almost daily contact with Carlsson and his crew. "Säffle Brunnsborrning is not just a loyal customer," he says, "The company places high demands on us that we have to meet."

Säffle also participated in a project to develop a new hammer specifically

> "In our business we rely on recommendations. That's how we get new assignments.

Daniel Carlsson Managing Director, Säffle Brunnsborrning

Sound investment: This year, Säffle Brunnsborrning, has taken delivery of a second complete set of equipment from Atlas Copco. Here, a new water well project gets under way in rural Sweden.

designed for geothermal and water well drilling and which was launched in March this year. "We wanted to offer a new generation of hammers for 35 bar that will run more smoothly and provide higher productivity," says Johansson. "To do this we have slightly reduced the force of each blow and combined this with a higher frequency."

The 'comfortable' hammer

After weeks of testing, Säffle confirms that it the hammer meets expectations. "We could tell right off that it runs in a more comfortable way," says driller Fredrik Johansson. "It makes things easier, particularly for the person standing at the machine. We have also noticed that it's more economical when it comes to fuel, compared to the previous hammer we had."

During testing the new equipment in a water well project, the rig drilled down to a depth of 110 m which resulted in a water inflow of 40–50 liters per hour.

"There was no point in drilling deeper," says Carlsson. "All we have to do now is pressurize the well in order to increase inflow."

Another problem-free day and another well job, done well.

A complete package

Atlas Copco provides a complete package of equipment and service for successful geothermal and water well drilling in all ground conditions.

WellDrill 3062

The WellDrill 3062, used by Swedish contractor Säffle Brunnsborrning, is a compact, versatile and reliable DTH dill rig for geothermal and water well drilling with modern technology.

It includes a flexible, 360-degree rotating rig for high production drilling and features an external control panel that logs drill speed, rotation speed, current drill depth, and also shows the number of drill rods added.

DrillAir Y35

Perfectly matched to the rig is the new DrillAir Y35, compressor. This unit is both shorter and lighter than its predecessor, and the working pressure range can be adjusted to suit all types of drilling and conditions.

New W4 hammer

In addition, Atlas Copco has also developed a new 4" DTH hammer with high productivity. The W 4 hammer, is less forceful and harsh on drilling components and also more fuel effiicient.

Service

Atlas Copco has dedicated service teams for this equipment combination, making service and maintenance easy to plan and cost-efficient. The Atlas Copco service vehicles are fully-equipped to cover most events that may occur onsite, and if more substantial maintenance work is needed this can be conveniently carried out in Atlas Copco's workshops.

PEARLS OF

The cutting edge machines that help leading dimension stone company meet global demand

Pearl Mineral and Mines, one of India's top suppliers of Black Galaxy stone, is meeting rising global demand for world class granites. Drilling technology from Atlas Copco is a key driver of the company's success.

With an abundance of granite, marble, sandstone, quartzite and slate, India is the world's largest producer and a leading exporter of dimension stone. Used in iconic buildings all over the world, Indian stone meets the most exacting world standards.

The southern state of Andhra Pradesh is home to one of the most popular granites of them all, known as Black Galaxy or Bronzite Gabbro.

INDIA

Dimension stone quarrying on a massive scale: C.V.N. Raja, Managing Director of Pearl Mineral and Mines Pvt. Ltd., describes the operation for M&C reporter in the Ongole quarry.

These medium-to-fine grained dark stones, which have golden, sparkling scales, are said to be found only in Ongole, a village some 350 km north of the City of Chennai.

Sitting on a 'goldmine' of this much sought-after material is C.V.N. Raja, Managing Director of Pearl Mineral and Mines Pvt. Ltd, which is quarrying an area of just over seven hectares.

There are about 50 quarries here, all focused on meeting the current high demand for Black Galaxy granite, mainly from China, but also from many other countries around the world.

As a first generation entrepreneur in the business, C.V.N. Raja started with pneumatic drills, compressors and a large workforce. But he soon realized that only advanced technology could help his company to surge ahead in this highly competitive market.

> I would not invest in high-end equipment if I could not be sure of after sales service.

C.V.N. Raja Managing Director, Pearl Mineral and Mines Pvt. Ltd

After a thorough study of the available options, he chose dimension stone drilling equipment from Atlas Copco.

"Advanced technology, innovative product design and total reliability are the key factors why I chose Atlas Copco," he says. "But what impresses me most is their commitment, service support and ready availability of spares, which are vital to keeping the quarry running efficiently."

High standards, quality products

C.V.N. Raja adds that whenever his clients from China, Hong Kong and Macau visit the site they are impressed with the standard of the operation and the quality of the products. And over the next couple of years, he expects his annual sales to increase from today's INR 600 million (USD 9 M) to 700 million (USD 10 M).

Clearly, the equipment will play a major role in reaching the goal. Ch.V.Srinivasa Murthy, Director, is responsible for managing the entire fleet as well as the operators, both in terms of safety and working conditions. Over a six year period, the fleet has been expanded to include 64 machines, and is dominated by units such as the SpeedROC D30, Rock Buggy and Dominator.

Driven by a strong desire for innovation and safety, he was first in the area to introduce radio remote control (RRC), first in the country to purchase the SpeedROC D30, and has now become first in the world to place an order for a SpeedROC 2F.

To determine the latest trends in the industry, C.V.N Raja listens to his clients and his technical team, but quickly adds: "I would not invest in high-end equipment unless I could be sure of after sales service and the ready availability of spares. Atlas Copco has been fantastic. They understand the needs of their customers, and are always available to give support."

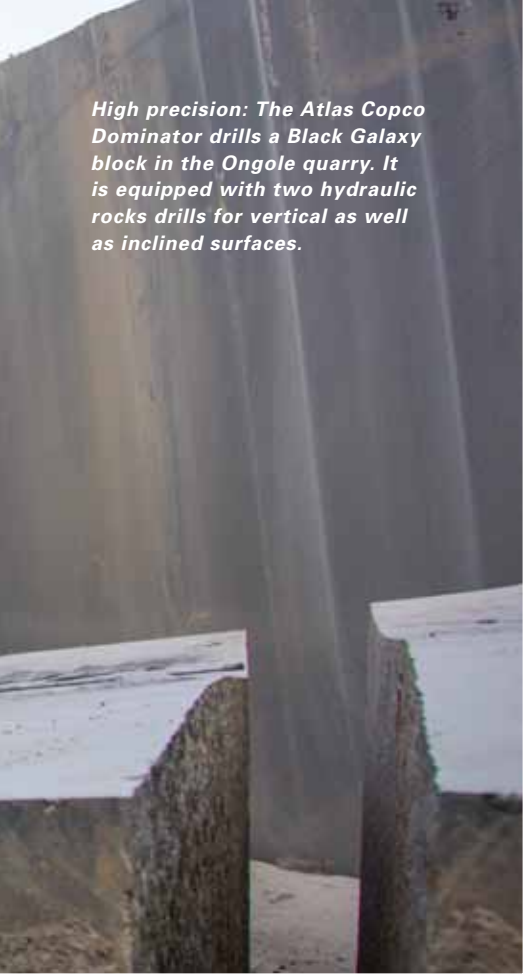
New technology, new image

With the introduction of new technology, C.V.N Raja maintains that the image of stone quarries is changing fast as they become more environmentally friendly.

One example, he points out, is the increasing use of wire saw cutting which has significantly reduced the use of explosives, making operations both safer and cleaner. Another is precision drilling. "We always use the latest equipment to get maximum accuracy in the size of the blocks," he says. "This means less wastage and less waste to dispose of."

Pearl's preference for Atlas Copco equipment is also evident in its choice of rock drilling tools. Having realized the benefits of mechanization, the company quickly graduated from the commonly used integral drill steels towards the more energy efficient tapered drilling tools which also offer more options to use different bit types and sizes.

That was about two years ago. Today,



High precision: The Atlas Copco Dominator drills a Black Galaxy block in the Ongole quarry. It is equipped with two hydraulic rocks drills for vertical as well as inclined surfaces.

Pearl reports 20% faster penetration in drilling operations overall, helping to boost production and sharpen Pearl's competitive edge.

Another key success factor is the Atlas Copco service engineers who can be accessed directly and through distributors. All dimension stone equipment used in the Hyderabad region is supported by the Atlas Copco distributor Airtech Machines and Tools Pvt, Ltd., in Chimakurthy, which holds critical components and parts for scheduled preventive maintenance.

Training a key issue

While he praises the development of new technology for stone quarries, C.V.N. Raja stressses that training is a major obstacle. He concludes: "Many others like me would want to have the world's latest technology in their quarries. I would like to see suppliers like Atlas Copco motivating the industry to interact with the government in setting up institutions, certificate courses and seminars to secure the availability of skilled manpower."

Footnote: Pearl Mineral and Mines has won many awards and accolades for its achievements including recognition this year from the Institute of Economic Studies of New Delhi.

The jewels in Pearl's crown

SPEEDROC D30, a flexible drill rig, ideally suited to the dimension stone industry (DSI). Used for primary cut drilling, the rig can be used for both horizontal and vertical drilling in wire saw applications. The machine has a skid-steer mechanism which gives it extreme stability while tramming, and the rod rack holds up to 10 rods of 2 m each that can be positioned on either side of the machine.

DOMINATOR, a versatile, self-sufficient, hydraulic operated drill attachment suitable for excavator mounting and drilling of vertical holes. Used in the primary cut and bench dressing stages of drilling, it is equipped with two hydraulic rock drills for both vertical and inclined surfaces. At Pearl Minerals, Dominator boosts drilling speed by up to 1 m/min for each rock drill. Together, the drills give a capacity of up to 1000 liner meters per day.

ROCK BUGGY, a small, compact, four wheeled drive tophammer drill rig designed for vertical drilling. It has a four-wheel drive and four steering wheels that give it high mobility and flexibility. An oscillating rear axle enables the rig to be easily maneuvered in difficult terrain. Guide rails up to 3 m in length enable rapid positioning and an anti-jamming system ensures precise, straight and parallel holes.

SPEEDROC 2F is the latest Atlas Copco drill rig assembly to join the Pearl Minerals fleet. It is a remote controlled rig equipped with two hydraulic rock drills for both horizontal and vertical drilling. Built for high productivity, its 360 degree, rotable, long-reach boom gives high speed, accurate drilling and excellent positioning and tramming. With its filtering area of 11 m^2 and suction capacity of 720 m^3/h, its dust collector helps maintain a good working environment.

NB: The blue color of some products featured in this article was the previous house color of the Perfora company, now a member of the Atlas Copco Group.

Kick-off for Stockholm bypass

The bypass gets under way: Boomer WE3 in action in the access tunnels.

SWEDEN The first access tunnels are now under construction for the planned bypass tunnel around the western perifery of Stockholm.

This new link in the European route E4 will be 21 km long, of which 18 km will be underground. It will have three lanes in each direction and in two separate tunnel tubes.

Czech contractor Subterra and Slovakian contractor STI are working to tight deadlines to enable the main tunnels to get under way by November.

Subterra is working two shifts at two tunnel sites and relies on an Atlas Copco Boomer WE3 drill rig to drill the blast holes.

"This is a great machine," says operator Daniel Lignell who has 10 years' experience of Atlas Copco rigs. "I liked the Boomer L2 och Boomer 353 but now I feel really spoiled!" Most of all he says he likes the new version of the Rig Control System RCS5 as well as the rig's touch screen display and two joysticks.

The new route will take 10 years to build and cost some EUR 3 billion. It is estimated that by 2035 the bypass will be used by about 140 000 vehicles per day.

World record raise at Boliden Tara mine

IRELAND Swedish drilling specialist Bergteamet has succeeded in raiseboring a ventilation shaft at Boliden Tara Mines, 848 m long and 4 m in diameter.

"A new world record in raiseboring using Atlas Copco equipment," says Magnus Johansson, Sales Manager at Bergteamet. "Hitting the right spot 848 meters down is a difficult task but we managed it with a margin of error of only 0.17 percent. It went incredibly well and the cutters held up all the way without having to be changed."

Bergteamet used an Atlas Copco Robbins 91RH, reamer model RXL and MCKC6 cutters. The project started on 28 November 2015 and finished on 9 February 2016, with a break for Christmas and one for repairs. The average boring speed was 0.88 m/hr.

The Boliden Tara Mine has been in operation since 1977 and is Europe's larest zinc mine with an annual production of 2.6 million tonnes of zinc and lead.

Record raiseborer: The Atlas Copco Robbins 91RH.

Controlling costs: Carlos Russo, Production Director at EPOS, obtained complete cost control with a Pay-Per-Use financial agreement for his modern drill rigs at the Marão Tunnel.

Pay-Per-Use A cost effective solution for contractors

PORTUGAL At more than 1 400 m above sea level, high in the Marão Mountain range, is one of Portugal's most treacherous roads. The winding and difficult terrain often causes long delays and frequent accidents, especially in winter, as local residents and visitors alike attempt to drive from Porto in the north, inland.

However, this dilemma is now a thing of the past. Tunneling specialist, Empresa Portuguesa de Obras Subterrâneas (EPOS), has successfully completed the construction of two parallel road tunnels running straight through the mountain.

Two challenges

EPOS achieved its goal with a combination of four Atlas Copco drill rigs – two Boomer XE3 C, one Boomer WE3 C and one Boomer E3 C – coupled with a Pay-Per-Use financial agreement.

Carlos Russo, Production Director at EPOS, says: "We had two big challenges on this project. The first was to get equipment with the highest possible availability. The second was to get total control over our costs."

Atlas Copco met both of these demands. Hugo Dias, Atlas Copco's Business Line Manager for underground mining and construction in Portugal, explains: "Together with EPOS, and based on the data we had gathered, we estimated all of the costs while the machines were running, including spare parts, drilling consumables and service. Then we calculated a fixed price based on the cost-per-cubic meter of the excavation.

"When the machines were running, EPOS was paying. When the machines were not running, they paid nothing. It was as simple as that." This arrangement gave EPOS total cost predictability.

The Marão Tunnel, which runs east to west, is 11 km long and has a cross section of 110 m^2 – the largest in the Iberian peninsula and one of the largest in Europe.

It was opened this Spring and significantly reduces the travel time between the northern part of the country with its inland. It has also improved road safety and opens up the Douro and Trás-os-Montes regions for further development.

Garpenberg mine goes remote

SWEDEN The Garpenberg Mine has increased its productivity and taken a step into the future following the introduction of remote control.

The first remote controlled drill rigs are now being tested and within the next few years the mine expects all of its rigs will be automated.

"We have started using remote control with the Atlas Copco Simba ME7 production drill rig, controlling it from a control room on the surface via the WLAN system," says Gunnar Nyström, Mine Manager.

"By September this year we aim to have three of these machines in operation, and by 2018 we will have four, all controlled from the same room."

Nyström says the main objective is to increase productivity as the rigs can continue operating during the hours the mine has to be cleared due to blasting, which is roughly 5 hr/day.

"Apart from that, it makes a big difference to the working environment," he adds. "We get away from the rig och can sit in a safe and comfortable room. I hope that together we can continue to optimize the remote control system, for example when it comes to bit changing and rod handling."

In control: Atlas Copco's M series rigs are key to the Garpenberg project.

Simply the best

ATLAS COPCO has won a prestigious award in Chile for its work as a supplier of equipment to the country's mining industry. Atlas Copco Chilena, was recognized for "Best Performance" in three categories – Underground Drilling, Underground LHD & Trucks and Surface Drilling – in the 5th Ranking of Suppliers, organized by Chilean consulting firm Phibrand.

The ranking was based on responses from 240 representatives of large mining companies and other managers from different areas of the industry.

Charlie Ekberg, Managing Director of Atlas Copco Chilena, commented: "This award is a reflection of our commitment to our customers. It demonstrates the quality and reliability of our equipment and strong support in aftermarket and technology innovation."

It is the second consecutive year that Atlas Copco has won first place in the surface drilling category.

The award was presented at the regional mining show, Expomin. Charlie Ekberg (third from left), with Business Line Managers, from left, Nelson Trejo, Vidal Martín, Omar Allel, Fernando Depix and Rodrigo Izzo.

Learning on the go

IT'S NOT JUST THE expense of transport, meals and accommodation which puts a hole in contractors' wallets in conventional operator training. The biggest cost item of all – time away from production – is just as crucial. To make the process of getting drillers using RCS (Rig Control System) up to speed in a faster, more convenient and affordable way, Atlas Copco has come up with the RCS Mobile Trailer, a concept that originated in South Africa following requests for flexible on-site training. The trailer is fitted with all the necessary technology to create a mobile training unit. With its powerful onboard battery system and fold-up chairs and tables, training can now be easily set up and carried out in the remotest areas.

MINEXPO 2016 INTERNATIONAL

THE UPCOMING MINEXPO show in Las Vegas, USA (26–28 Sept.) will highlight innovative solutions to the tough challenges currently facing the mining industry. As one of the leading participants, the Atlas Copco display will be packed with innovations for both surface and underground applications.

With the theme "The Future of Mining is Now", the booth will feature the new Pit Viper 275 Autonomous Drill and Remote Operations Center that pushes the boundaries of today's surface drilling operations. In addition, the Pit Viper 231 drill rig and the rig control system "RCS lite" will be featured, demonstrating a commitment to more value and lower operational costs.

Other highlights will include the new SmartROC COPROD rig, the BenchREMOTE remote control station and new exploration rigs Christensen 140 and Diamec Smart 8.

For underground applications, the display will showcase a new Minetruck, a revolutionary new drill rig and the Easer mobile rig.

Last but not least, visitors will be able to try out a training simulator for operators of Boomer S2 drill rigs and also see how the new Certiq telematics system provides real-time data on machine performance and maintenance needs.

Atlas Copco Presents

On your screens now! The SpeedROC 2F, Simba S7 and Certiq telematics system are just three of the many Atlas Copco innovations currently being showcased on YouTube.

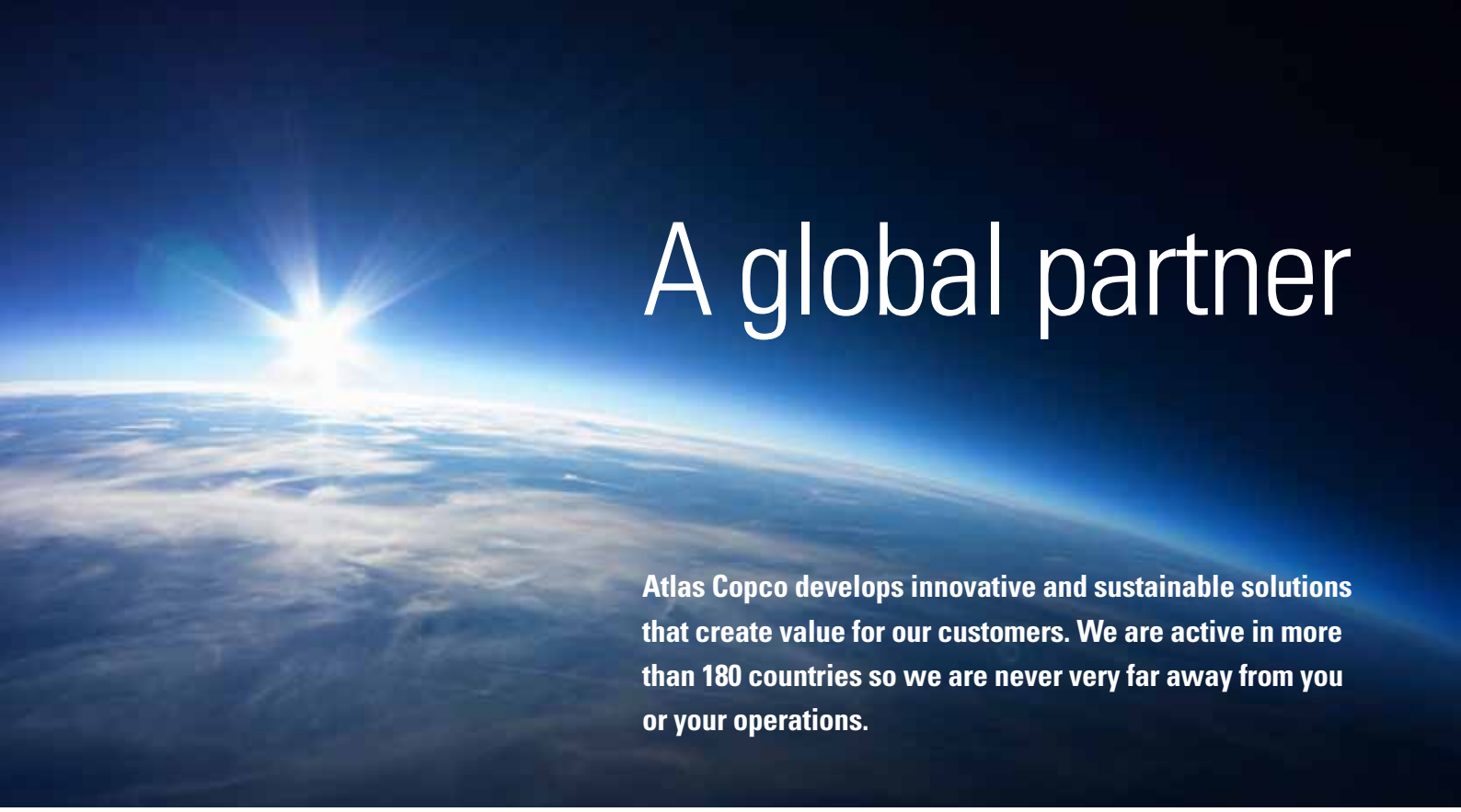
A VARIETY OF NEW VIDEOS are now available on YouTube, presenting the latest products and technology developments from Atlas Copco. The themes include dimension stone drilling, high precision in underground mining, telematics, automation in surface drilling and much more. See all the action at the following links:

www.youtube.com/AtlasCopcoUG

- **Ideas Move Mountains:** youtu.be/1ot2Nd4oWPE
- **Block Caving Mining Method:** youtu.be/MVDAw56s5dU
- **Case video – Pay per Use:** youtu.be/ttaVP7a9onk
- **Case video – Take the old out of gold:** youtu.be/FISJX2Uj4t4
- **Simba S7 trick shot:** youtu.be/-MUdC7ou2_c
- **Behind the scenes – Simba S7 trick shot:** youtu.be/DMIxx12u9YA
- **Scooptram ST7 Battery – a deep breath:** youtu.be/LyZPAGZLUtM

www.youtube.com/atlascopcocmt

- **Walkaround FlexiROC T30 R** youtu.be/vuaid49Teto
- **SmartROC C50** youtu.be/1m5lJALNFOs
- **SpeedROC 2F** youtu.be/H4ffL5O7Ymg
- **BenchREMOTE** youtu.be/ALGo0w7g3LE
- **Smarter Quarrying** youtu.be/yp1QacdySzE
- **Diamec Rod Handler** youtu.be/2SrC68kvoCw
- **Certiq – a telematics solution** youtu.be/XNxDPmqEuMo



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