

# Better blastholes

*Drill automation research has suffered at the hands of the recession but advances continue to be made. **John Chadwick** and **Daniel Gleeson** consider these and of course the new rigs out there*

Automation is the technology that many large surface mines are looking at closely. Drilling automation means many different things to different people - it can range from anything that reduces the amount of manual work to fully autonomous operations of various drilling systems. Sandvik is, as a company, heavily invested in developing a full range of automation projects for its mining equipment. In 2009, the company is launching multiple 'Automation' packages for the blasthole drills product line, designed for both the new product range, but also as retrofit kits to support customers who already have made the investment in Sandvik equipment.

*Automation requires full simulation and verification in a controlled environment. Here shown applied to a test wall for blasthole drills, the functionality and response of the control system is tested and refined in a Sandvik R&D facility. The control system is identical to that of an operational drill, with the only difference being that the inputs to the sensors are artificial to simulate any normal operation or unintended events. According to Sandvik, the software engineers depend on the real world experience of operators and technical specialists to develop the system as well as necessary checks and balances*

Specifically, Sandvik is introducing an Auto Levelling system for blasthole drills, allowing the rig to be levelled automatically thus reducing both operator set-up time and also reducing unnecessary stresses on the rig frame components themselves. Additionally, instrumentation upgrades to improve reliability

and decrease failures in the field will be introduced for rotary head speed monitoring and hole depth measurements.

Sandvik already has a solid platform in the control systems on the latest generation topammer drills, which allows for optimising penetration rates, anti-jamming, pipe handling,



# SURFACE PRODUCTION DRILLING



Aitik's first Atlas Copco Pit Viper 351 was delivered in December 2008 and was fully assembled and set up for test drilling by January 7

and one-hole automation. Sandvik is also studying the systems requirements for tramming and hole setup, and in particular the communications and safety standards that have to be met to make them viable in real mining operations.

Automation has taken a hit with the global recession. As noted in the Leader to the May issue, Rio Tinto is carrying on with its program in the Pilbara iron ore in Western Australia, which includes its own drill automation as well as collaborative work with Atlas Copco.

Freeport McMoRan Copper & Gold had a mining technology program in which it was investing \$30-40 million. Sadly this was stopped at the end of 2008, and its well experienced team was dissolved. Automated production drills and other equipment, high-speed wireless communications, full GPS and inertial navigation, and integrated real-time mine management systems were at the core of the Phelps Dodge/Freeport program, with the company working with a number of leading OEMs and technology providers to develop systems to meet its specific needs.

## Arctic Vipers

Sweden's Aitik copper mine (*IM*, March 2009) near Gällivare, north of the Arctic Circle, is doubling ore production to 36 Mt/y – with the help of Atlas Copco blasthole drills. Four Pit Viper 351 rotary drills have been purchased for the task and Boliden, the owner, plans to put all four into

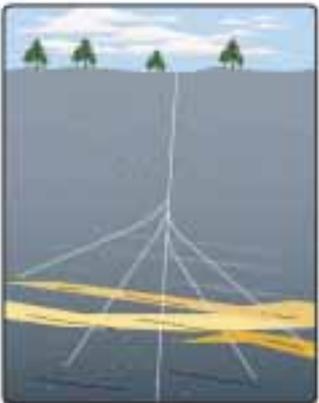
operation this year. Two are already on site and will be joined by the second pair in the summer.

Stig Fredriksson, Atlas Copco's local representative, reports: "The whole thing went very smoothly. There was a team of four, plus a couple of electricians, and they got the rig up and running in just a couple of weeks. They were assisted by Pit Viper expert John Green from the US and our site manager, Stefan Kuoppa. The assembly of the remaining three rigs should take even less time as the guys now know the procedure."

Gällivare's five-man Pit Viper drilling team is currently being trained to use the new drills. Their state-of-the-art technology includes the RCS (computerised Rig Control System), GPS positioning, MWD (Measure While Drilling) functionality, automatic drilling and levelling, and more. "The technology is one of the main reasons why Boliden chose the Pit Viper 351," says Fredriksson: "It makes the drill rig very efficient, effective and easy to handle. For example, the RCS system enables the rig to collect and store drilling data, communicate via



RCS basic replaces electric joysticks (top right) in the latest Atlas Copco Pit Vipers, PV-271/5 (above) and PV-351 (right)





World Leading within Directional Core Drilling & Borehole Surveying Instruments

**Core drilling the smart way**

Reduce exploration time & cost  
 Improve accuracy, hit the targets  
 Multiple sidetracks  
 Deviation control  
 Reduce environmental impact

Devico AS - P.O. Box 206 - N-7224 Melhus, Norway  
 Phone: +47 72 87 01 01 e-mail: devico@devico.no web: www.devico.com

## SURFACE PRODUCTION DRILLING

a PC card with the mine office and simplify service and maintenance."

In a far hotter climate, in Northern Nevada, Newmont Gold operates its Phoenix mine where planners knew at that start in 2006 that they would face an extraordinary geological challenge. The mine contends with quartzite rock that is among the most abrasive of its type in the world. The extremely difficult ground condition was among the toughest challenge the planners had ever faced. "Anything that touches Phoenix rock wears fast," says Mine Manager Mark Evatz. "But the Pit Viper is big and bad and can take it."

He is referring to the fleet of six Atlas Copco Pit Viper 271s, which due to the tough rock conditions require hammer drilling and are equipped with Atlas Copco TD65 hammers, 165 mm bits and 41 m<sup>3</sup>/min, 2.4 bar oil-flooded air compressors. An Atlas Copco DML and a DM45 mid-range blasthole rig are also included in the fleet.

The mine's goal is to keep some 4 Mt of muck in inventory to stay ahead of the shovels and support operational flexibility. Drilling efficiency has been a priority for



For easier maintenance access, the P&H 320XPC features a roomy, well-lit machinery house

continuous improvement from the start. The 16.5 m single-pass depth capability of the PV-271 has contributed to this. Originally, the plan called for 6.1 m benches, and 7 m drill depths but the time spent moving from hole to hole had a negative impact on productivity. That plan resulted in drilling an average of 14.3 m/h. When drill depths were increased to 13.4 m, supporting the blasting of 12.2 m benches, the mine was able to use the single pass capacity of the PV-271 and performance increased to more than 18.3 m/h. This is still low compared with other Newmont mines drilling 37 to 40 m/h, but that is the penalty of the rock hardness at Phoenix.

Nevertheless: "We are below our budgeted drill costs," says Evatz. "This is partially because the best cost comes from hammer drilling when in hard rock." Pat McAmis, General Foreman, Maintenance Planning, agrees. He says: "You can try to put more drills on the bench, but space and costs don't make that practical."

The mine focuses on maximising the fragmentation of blasted rock while maintaining a minimum dilution. Walt Holland is Maintenance Superintendent at Phoenix. "The rock hardness at Phoenix is

**Rock Drilling Tools**

- Striking Bars
- Rock Bits
- Drifter Rods
- Drill Rods
- Taper Rods
- Male/Female Rods
- Integral Drill Steel

**Longevity... Customer Support... Quality Manufacturing...**  
 If these are qualities you require, then look no further. Brunner & Lay has been established as a leading supplier of Rock & Demolition Tools for over 125 years. Our experienced engineers, technicians, and support staff are dedicated to satisfying your product requirements.

**Brunner & Lay**  
 "Quality First" since 1882

<p><b>Rock-Bit Division</b>                  1510 N Old Missouri Rd                  Springdale, AR 72764                  ph 479 756-0880</p>	<p><b>Demolition &amp; Export Division</b>                  9300 King Street                  Franklin Park, IL 60131                  ph 847 678-3232</p>
--	--

Toll Free 800 872-6899 [www.brunnerlay.com](http://www.brunnerlay.com)



All Terex rotary blasthole drills, including the SK-L, are manufactured with the patented Hydraulically Operated Break Out wrench (HOBOW), designed to increase drill productivity. It allows for a method of breaking joints that is both simple and safe for the operator

unique to the world," he explains. "What I like about the Pit Viper is its quality. I am getting 92.5% availability and that is really good. We have a great history with Atlas Copco and have worked right through any issues that have come up.

"Phoenix is successful because we don't get conflicting missions. We work well together and challenge

each other. The ground is unforgiving at Phoenix and it takes a team approach to be successful. When mechanics and operators are talking, you know you're winning."

These Pit Vipers use Secoroc's TD 65 down-the-hole (DTH) equipment, a robust, high-powered rock drill designed for high productivity in combination with large drill rigs. At Phoenix it uses 165 mm button bits but will also take bits up to 216 mm. Atlas Copco says the TD 65 is "the most powerful hammer on the market, delivering 2,160 blows per minute at the maximum air pressure of 30 bar."

Jim Wheeler, Atlas Copco's Senior Area Manager, says the TD 65 was chosen for its high penetration rate and that has proved a good decision. "The hammer has been in daily operation since the Pit Viper arrived at the site and everything is going well. We are getting a penetration rate of 20-50 m/h." About 150 bits are used per month, and in these extraordinarily abrasive conditions, regrinding is not considered an option. However, in order to reduce bit consumption as much as possible, Secoroc has changed the carbide in the buttons to a tougher grade.

Other hammers previously used at the mine did not stand up as well to the abrasive conditions, particularly the outer parts which are usually the first to wear down. However, on the TD 65, the backhead, hammer case and

## The Most Versatile and Productive Boom Mounted DTH Drill...

# QXRgen V

FIRST In Its Class

The QXR generation V open pit DTH drill is more powerful, productive, and flexible, and when combined with faster set-ups and recognized hole accuracy, provides our customers with the lowest cost per ton for their mining operations.

The QXR gen V includes the First In Its Class 500psi 35.4 bar air package, as well as the Cubex Drill Management Center™: an electronic hole management system that assists the operator in monitoring important drilling functions, taking full advantage of the time saving and performance features designed into each QXR gen V.

Production    RC Sampling    Pre-Split

Setting new standards with measurable performance.

CUBEX

www.cubex.net

1215 Henderson Street, Box 13, Group 524, RR 5, Winnipeg, MB Canada R2C 2Z2 Phone 204 694-5505

## SURFACE PRODUCTION DRILLING

chuck all use a thicker material. This allows more drilling before replacement parts are required. Cutting backheads – cemented tungsten carbide inserts – protect the hammer and case against wear. They also help to prevent the hammer getting stuck in the hole. In addition, the TD 65 has a reversible hammer case so when the lower end becomes worn (most of the wear occurs from the bottom up), it can simply be disassembled, flipped over and drilling can continue.

Atlas Copco estimates that the hammer can normally be rebuilt two to three times before the outer parts need to be replaced. Other features designed to give increased productivity include a

special 'hardbody' chuck, a patented Quantum Leap air cycle which powers the piston to more than 80% of the stroke and a patented Air Select regulation system which enables the air consumption of the hammer to be more precisely matched to the air output of the compressor.

P&H Mining Equipment's most advanced heavy-duty mining production drill yet – the P&H 320XPC – was designed and built for difficult and demanding drill-and-blast operations in iron ore and copper mines. P&H engineers teamed with P&H drill customers and P&H MinePro Services customer support personnel to identify, understand and close myriad systems and maintenance performance

gaps. Those efforts resulted in the rugged P&H 120A production drill that is well regarded for its performance in difficult mining environments. With the availability of the powerful next-generation P&H Centurion™ supervisory control and data acquisition (SCADA) system, P&H Mining Equipment drill designers combined all of those advances plus many more to optimise drill platform performance with the roll out of the P&H 320XPC in late 2007.

Three primary solutions were designed in – rugged structural and mechanical design, smart systems control, and overall ease of maintainability. The P&H 320XPC is rock-solid from its deep-section, cross-brace-reinforced mainframe and similarly rugged crawler system up to and including its stout mast and rotary-pulldown carriage. Finite element analysis was applied to help ensure the structural integrity of the mast and mainframe built to ISO 9000 manufacturing quality standards. Severe-duty P&H electric motors and transmission components comprise the rotary-pulldown carriage that advances the drill string with positive drill bit loading made possible by a proven rack-and-pinion configuration.

With large bailing air velocities of up to 109 m<sup>3</sup>/min combined with up to 68,038 kg of bit loading and up to 33,895 Nm of torque, the P&H 320XPC is a high-penetration production drill for blastholes up to 444 mm in diameter down to a standard, single-pass hole depth of 19.9 m, or optional 21.3 m.

An all-new drill system operator cab draws upon the great power of the P&H Centurion control system to assert increased control over the health and performance of the electrical and mechanical systems of the 320XPC. A powerful ABB supervisory controller linked to a neural network of input/output drops throughout the drilling rig provides the drill operator – and mine maintenance management as well – with real time information vital for needed systems control, health monitoring and faster troubleshooting. Access to P&H Centurion system information is obtained via an intuitive, touch-screen graphical user interface (GUI).

P&H Centurion helps ensure that drill systems perform within safe and optimal operating parameters. One example is the control it exerts over the twin P&H electric motors mounted to the rotary carriage, ensuring matched, master-follower true torque-share loading for optimal, balanced power applied to the drill bit. The system automatically monitors and applies correct load balancing after maintenance or motor change-outs.

P&H Centurion manages the P&H 320XPC auto-drill system that determines and applies

**"WE'RE DRILLING 300% FURTHER ON A SINGLE BIT!"**  
- Drill Operator, Ontario, Canada

The Stage3 Diamond Coring Bit  
[www.boartlongyear.com/stage3](http://www.boartlongyear.com/stage3)

BOART LONGYEAR IS A LEADING PROVIDER OF:

- GLOBAL DRILLING SERVICES
- EXPLOURATION TOOLS AND EQUIPMENT
- ROCK DRILLING TOOLS AND EQUIPMENT
- GEOTECHNICAL AND BIOMECHANICAL TOOLS AND EQUIPMENT

From Olympic Dam, South Australia to Sudbury, Ontario, drillers continue breaking records with the new Stage3™ coring bit!

There is a good reason we've been a guiding force for more than a century. It is the trust our customers have in our rich history and dedication to innovations like the original Q® wireline system and, now, our 25.4 mm Stage3 diamond coring bit.

Talk to your Boart Longyear® representative, setup a demo and make the switch to Stage3. You won't believe the improvement in speed and depth you can achieve until you have this bit in the hole.

Download case studies, tech data and additional material at [www.boartlongyear.com/stage3](http://www.boartlongyear.com/stage3).

**BOART LONGYEAR**  
[www.boartlongyear.com](http://www.boartlongyear.com)

*Schematic of a bit entering the chamber of the new Bucyrus Auto Bit Change Carousel*

optimal loading forces to the drill bit. It also contains ample capacity to handle auxiliary drill control systems including GPS-assisted positioning and important drill management control technology on the horizon.

Rounding out the smart systems control features is the P&H SureWrench II™ breakout wrench system. This provides increased clamping force (45,359 kg) and twice the breaking torque (90,718 kg) of P&H SureWrench.

Over the past two years, a total of 14 new 320XPCs have been – or soon will be – placed into service in mining operations marked by very harsh environmental conditions. Of these, 11 are in iron ore, two in copper and one in a diamond mine.

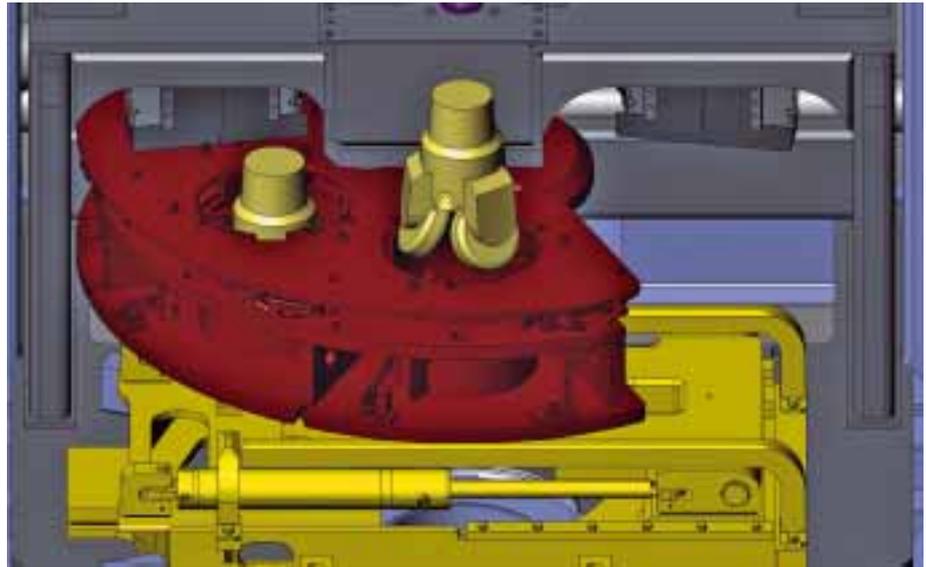
## Operator safety

Suppliers have all put a lot of research and development into rod handling and bit changing recently, to avoid nasty accidents to operators hands and backs. Bucyrus International has recently introduced a new rotary bit change carousel and forked pipe wrench for its 49 Series rotary blasthole drills. It says that by “fully automating the drill bit and pipe change process, Bucyrus has eliminated the safety risks and lost production time associated with these operations.” These Bucyrus 49 Series improvements are available for both new drills, and as a retrofit on existing drills.

The Auto Bit Change Carousel allows up to four drill bit changes to be conducted remotely from the operator’s cab, reducing the typical change-out time of 60 minutes to a mere 10 minutes. That’s an 83% productivity improvement! In addition, the carousel eliminates seven safety lifting hazards, and avoids the need for drill operators to work under a suspended load.

The forked pipe wrench simplifies pipe unthreading during the drill bit change-out process. First, the forked wrench engages the drill pipe flats. The wrench then rotates, impacting the stop block, causing a break in the pipe thread joint. This new feature reduces the change-out time and the safety risks associated with drill pipe assembly and disassembly.

The new **Terex Reedrill** SK-L rotary blasthole drill has a 20-m, single-pass mast that accommodates 30° angle drilling and multi-pass hole depths up to 65 m. The unit can be operated in extreme heat, cold or altitude because of a split cooling system, variable-



speed fans and cold weather packages. It is designed with high ground clearance and a low centre of gravity for the most challenging conditions. Increased stability allows quick movement from hole to hole. Filters, drain and fill points plus level gauges and dipsticks are positioned to facilitate daily maintenance. An ergonomic split-console reportedly features one of the best decibel ratings in its class. Smart drill programmable logic controllers help reduce drilling cycle times.

TECHMO is a name that may be unfamiliar to many, but this Austrian manufacturer produces excavator mounted drill feeds, crawler drill rigs and DTH hammers; all tailored to the individual specification of the customer. Its line of excavator mounted drill feeds (ranging from EMF 100 to EMF 160) differ in length, weight and power of the hydraulic hammer, with the EM140 and 160 equipped for DTH drilling. Boom and live ring of the excavator also ensures a wide-reaching operating range and a swivel range of 360°. Its line of crawler rigs include the TM105 drill rig which is used for surface blastholes, the TM205 drill rig, and the TM255 drill rig,

which has a telescoping boom equipped with a roll over device allowing drilling in all directions. Both the TM205 and the TM255 are equipped with the TECHMO TM3XL DTH hammer.

## Tools in the hole

Drill bit engineering and correct operation is a vital component to achieve maximum efficiencies. **Varel International**, used an engineering approach to achieve its most recent mining innovation, the D-Force roller

# DRILL MORE

[www.rockmore-intl.com](http://www.rockmore-intl.com)



For more than 60 years, Rockmore International has provided innovative drilling solutions, with manufacturing centers in two hemispheres and a global distribution network. Rockmore high performance drilling tools exceed the toughest demands in mining, construction, and water-well percussive drilling applications.



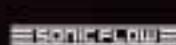

**Rockmore International**  
Wilsonville, Oregon USA  
Tel (503) 682-1001  
[info@rockmore-intl.com](mailto:info@rockmore-intl.com)

**Judenburg, Austria**  
Tel +43 3572-86300  
[austria@rockmore-intl.com](mailto:austria@rockmore-intl.com)



ROCKMORE®  
INTERNATIONAL

Rock Drilling Tools





Varel's D-Force bits were the by-product of extensive analyses on drill bit wear and failure modes and life ending attributes of drill bits in differing terrains

cone bits (see *IM* December, MinExpo review article). This innovation was fuelled by a systems-based, closed loop improvement cycle, in which products and applications were analysed with consideration for the entire drilling system.

Field engineers continue to look for performance improvements by way of this closed loop system; drill bits are constantly analysed for indications of possible areas of improvements. Additional resources used in this continuous improvement cycle include:

- Air testing services - globally deployed air test kits are used to better understand the air flow capabilities of customer's drills in order to improve drill bit and total drilling cost performance. The tests can determine actual compressor output at mine site, detect compressor weakness and can be used as a base point for other air tests. Additionally, the tests can indicate air loss in drill string, restrictions or other situations requiring maintenance
- Load evaluations - load cell evaluations, or pull down tests, are used to calibrate drill readings with the test readings. This allows personnel to gain insight into the actual axial force being applied by the drill on the drill bit, providing results that can lead to extended product life and substantial cost savings
- Bit schools - Varel has a long tradition of providing bit schools at customer locations. These classes not only impart drill bit knowledge and experience to mine operator personnel, they also help to focus drilling

teams on drilling processes and performance improvements.

**Brunner & Lay** has developed a new bit and drill steel for drilling straight holes in the 102 to 152 mm range. The 60mm B60 thread is designed to give long life and uncouple easily for a quicker overall hole time - every time.

#### Drop Center



#### Retrac



#### Drop Center

The company says its B60 bits and steels "were designed with the driller in mind. There is no need to waste time trying to uncouple the drill steel or bit due to a stuck joint. The B60 bits have been designed to provide the fastest, smoothest penetration while giving the maximum life and straightest hole possible. This fresh bit design takes full advantage of the new large high powered top-hammer drills. All of this means more holes at the end of the day."

Sandvik is now offering its line of rotary drill pipe tools globally. The line is built to withstand extreme torsion and axial loads with continuous testing and analysis at the company's Materials and Reliability Engineering Centres providing a comprehensive understanding of the customer needs from this product line. The line consists of:

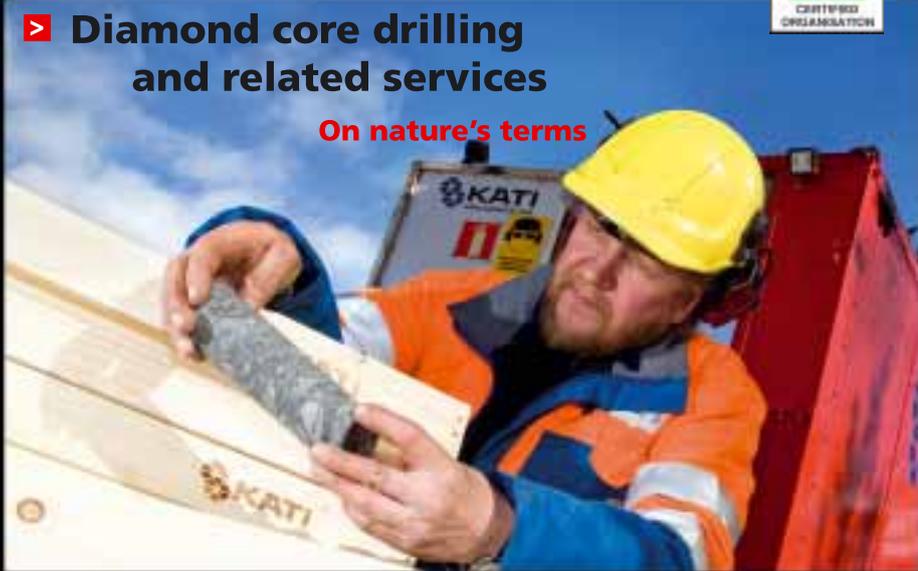
- Drill pipe - made from premium quality, heat-treated seamless tubing, it is available in ultra premium grade (special alloy) for hard abrasive formations, and premium grade for non-abrasive formations. Outside diameters are available from 76.2 mm to 339.7 mm
- Rotary subs and adapters - bit (bottom) subs, top (spindle) subs, cross-over subs and thread-saver subs available, manufactured with stringent heat treatment specifications
- Stabilisers - two designs available: 1) welded blade, with an integral fixed blade design with no moving parts, optimal for scraping; 2) rotating roller, incorporating Sandvik's tungsten carbide inserts that are resistant to breakage and wear
- Deck bushings - static or rotary, they run smoothly and provide extended trouble-free operation
- Shock subs - reduces drill string vibrations which minimise rotary head wear and damage while insuring a constant bit-on-bottomhole cutting action. *IM*





## ▶ Diamond core drilling and related services

On nature's terms



OY KATI AB KALAJOKI  
www.oykatiab.com

Sievintie 286  
85160 Rautio, FINLAND

tel. +358 207 430 660  
fax +358 207 430 661