Beyond blasting

Dan Gleeson looks at innovations in the explosives and blasting sector, with one eye on automation and wireless detonation procedures

“The downstream impact of variable and poorly controlled blast outcomes today can impact as much as 80% of total mine processing costs,” Rajkumar Mathiravedu, Vice President of Digital Solutions for Orica, says.

This opinion, on top of the safety and environmental benefits that come with optimising and automating blasting processes, has got miners looking upstream of the plants and mills they have already squeezed dollars and tonnes out of to improve their per tonne cost base.

By investing in the appropriate explosives, the way these explosives are positioned and stabilised, the accuracy of the blastholes drilled and the detonation procedure – pre- and post-blast – companies can make a material difference to their bottom line.

There is no one-size-fits all approach to this; every blasting pattern at every mine site is different and the choice of explosive is often dictated by logistics and availability as opposed to what may be optimal for the application.

It is for this reason that those supplying services, equipment and materials to this segment of the market are being asked more of from the mining community, with miners often looking to these companies’ in-house engineers for advice on how best to set up and carry out blasts.

Optimal blasting

As with all parts of the mining process, the concept of automation is being readily discussed in blasting and explosives circles – whether that be using robots to load blastholes or automating the detonation procedure.

Unlike other parts of the mining process, however, blasting remains today a largely manual exercise, according to Mathiravedu.

Orica is leading the sector’s transition, he says, working in partnership with customers and the industry to develop new technology to automate and, therefore, improve the blasting process.

For starters, however, Mathiravedu believes companies need to look upstream of blasting to achieve the holistic process improvements miners are after.

“Achieving dynamic blast optimisation requires a better understanding of the resource,” he said. “By understanding the resource at the start of the blast process, we can deliver targeted outcomes against our customers’ exact needs.”

One example of this early-stage analysis is a METS Ignited funded partnership Orica is involved in with IMDEX, Anglo American, Teck Resources and the CRC-ORE on a material characterisation project for optimised blasting and material tracking.

“The project involves the co-development of an autonomous system for logging material characteristics of blastholes, which allows automated spatial domaining of physical properties and fracturing,” Mathiravedu said.

This is focused on the development of multi-parameter logging tools for blastholes in open-pit mining, together with automated near-time analytics for input into fragmentation modelling, blast execution tools and material tracking workflows, he explained.

The company has also invested and worked with Silicon Valley start-up, DataCloud and its RHINO™ Seismic While Drilling system.

Mathiravedu explained: “DataCloud’s revolutionary new...system is a real-time subsurface measurement technology that provides high-resolution rock mass data through vibration measurement on internet of things (IoT) sensors. This enables accurate detection of faults, fractures, and joint spacing, in addition to many grade indicators and blast-critical measurements.”

These collaborations are integrating vast amounts of complex geotechnical data into Orica’s blast design processes, “influencing the overall blast design and ensuring the right explosives are delivered into the right holes and given the right timing to achieve the desired outcomes,” Mathiravedu said.

MAXAM, too, says it is aware of the productivity improvements seen across the entire operation when drilling and blasting is optimised.

“Mines are recognising that, while drilling and blasting constitute a tiny portion of the mining costs, they have a significant influence on the performance of all downstream operations, and to the impact on the environment,” Vicente Huélamo, Technical Services Director, told *IM*.

“As a result, we work with our partners on customising the drill and blast solutions for each specific requirement.

“This can range from using explosives with a broad range of energies and densities, to controlling how and when the rock is produced, and control how that rock affects the performance of excavation, hauling, crushing and milling,” he said.
Braden Lusk, Vice President of DynoConsult, a part of Dyno Nobel, says the development of products to improve processing costs and energy use downstream of blasting is a major industry thrust right now. "We are aware that nearly every company is trying to position themselves to offer the most efficient blasting products, supplies, and services to accomplish optimised blasting," he told IM.

But, this mine-to-mill study and practice is nothing new, according to Lusk. "A quick look in the literature will uncover decades of work focusing on this topic exactly. The real focus in the modern context is being able to optimise blasting parameters and product selection in real time with large amounts of data input."

Dyno Nobel is working on platforms, dashboards, and analytics to achieve optimisation as blasting commences, he said. "Our bulk technology allows us to customise loading down to very specific detail based on incoming data from smart drills, core drill information, or operational knowledge," Lusk said.

The company has major open-pit customers that have experienced very large cost savings in energy consumption from processing on top of a reduction in drill and blast costs over the past few years, according to Lusk. "In some cases, the savings add up to multiple millions of dollars."

Measurement technologies, aimed at replacing today's manual processes and improving future drill and blast outcomes, also have a part to play in this wide-ranging focus, according to Orica.

For example, the company has recently released its latest version of binocular image capture system, FRAGTrack™. This technology captures 2D and 3D blast fragmentation imagery and data, while automatically analysing said data.

FRAGTrack is designed to improve productivity and optimise drill and blast through the integration of fragmentation data into the drill and blast planning and design processes. Using this data, blast designs can be optimised to ensure fragmentation meets the necessary sizing requirements for reduced processing costs through fewer crusher blockages, reduced energy usage, enhanced diggability and haulage, and increased plant throughput delivering significant value.

This can have a positive knock-on effect to the excavation, load and haul and processing stages of the mining operation, according to Orica.

Orica's ORETrack™, meanwhile, traces rock material from a blast right through to the plant. The small RFID tags are set into boreholes prior to blasting and track the resulting ore through to the processing plant, enabling full transparency of the effect the blasting process has on the ore.

Going wireless & robotic
Orica's WebGen™ wireless initiation technology is a major part of the company’s automation push, according to Adam Mooney, Vice President – EBS, Wireless & Automation.

The first “truly wireless initiation system”, Mooney labels WebGen as a “game-changer of modern blasting” and a critical first step in fully automating the drill and blast process.

He continued: “It improves safety by removing people from harm's way, enhances productivity by removing the constraints imposed by wired connections and is fundamentally changing the way blasting and mining is approached by enabling new blasting practices.”

The system provides for groups of in-hole primers to be wirelessly initiated by a firing command that communicates through rock, water and air, according to Orica. This removes constraints often imposed by the requirement of a physical connection to each primer in a blast and unlocks safety and productivity benefits for customers by eliminating the need for down-wires and surface connecting wires.

The introduction of WebGen has, to date, facilitated seven new techniques for executing mining operations, according to Orica. This includes the temporary rib pillar (TRP) method, currently used by Newmont Goldcorp's Musselwhite operation in Canada. The use of TRP has helped increase ore recovery through a 34%
dilution reduction and facilitated a 20% improvement in mucking productivity at Musselwhite, according to Orica.

Orica’s WebGen technology has also led to the development of other methods such as:

- Temporary uppers retreat pillar;
- Reverse throw retreat;
- Longitudinal transverse retreat;
- Pre-loaded retreat;
- Transverse TRP, and;
- Longitudinal transverse lifter.

This is not all WebGen and Orica’s automation-focused technologies have helped facilitate.

Mooney said: “In underground mining, hang-up blasting poses a major challenge for block and sub level cave mines around the world. At any one time, up to 30% of all drawpoints can be unavailable due to oversized material. Concerns around safety are also more pronounced in underground mining.

“In aiming to ensure the safety of every miner and increased productivity for our customers, we have developed the first fully tele-remote and mechanised drawpoint hang-up blasting solution with MacLean Engineering.

“Underpinned by our WebGen wireless technology, the mechanised units, which have been fully tested, are capable of charging up to eight blast holes remotely without the need to tie-in detonators, removing people completely from harm’s way. We expect our units to be commercially available from later this year.”

And, in open-pit mining, the first phase of the company’s developments is to automate the explosives loading process.

“This phase is underway and will see us make our Mobile Manufacturing Units (MMU™) completely self-reliant, and is expected to be completed by 2021,” Mooney said, explaining that the automated delivery systems will reduce human exposure to hazards and “open up new value opportunities for customers around the world”.

DynoConsult’s Lusk says the safe handling of explosive products has been a major industry concern with automated blasting, but Dyno Nobel is currently engaged in projects that will allow for varying levels of autonomous loading and blasting.

“The loading equipment we use is already doing some automated hole loading based on our DynoLogix systems for bulk trucks on the surface and DynoMiners underground,” he said.

The initiation systems are a bit more difficult to load in an automated system due to handling issues and wires or tubes needing to connect to a blasting circuit, according to Lusk.

“Nevertheless, Dyno Nobel is committed to putting technology at the forefront of our business, and automated loading is under development.”

Automation and digitalisation of the drill and blast process are also key parts of MAXAM’s R&D focus.

The company is currently engaged in the Spain-based TUÑEL investigation project, which looks to address the competitiveness of the drilling and blasting cycle in mining and underground works, “through the conception of new techniques of engineering, explosives, prototypes and advanced tools” to be used in tunnelling, Huélamo said.

“Advanced tools like our RIOBLAST software suite and the Continuous Improvement Program, which are already creating value for our customers, are being integrated with drilling and blasting equipment to provide seamless, real-time blast data modelling and simulation to tailor the outcome of each individual blast,” he said.

MAXAM’s in-house RIOBLAST software can be applied to specific blasting problems by performing design and predictive simulations on charging, timing, ground vibration and fragmentation before the blast, according to MAXAM. It can also provide post-blast measurements as required (powder
and energy factors; rock volumes, fragmentation, environmental monitoring – ground vibration, air-blast overpressure, fumes, and others), according to the company.

Tailored treatment
Dyno Nobel is collaborating with customers to “ensure adjustments and practices on the bench translate to cost savings or productivity improvements in the processing and/or milling process”, Lusk says.

He said Dyno Nobel is concentrating its efforts on adjusting blasting procedures or products to influence the efficiency and costs of downstream processes.

“Dyno Nobel has numerous examples of the ability to alter fragmentation through product selection, explosive distribution, and/or other incoming data sources,” he said. “The key indicator in all of this is: what fragmentation distribution minimises cost in the mill and is this minimised cost enough to offset changes to drill and blast costs upstream?”

Each case is unique, he says, but there are times when pattern and product adjustments lead to both processing cost savings and a reduction in drill and blast costs. “In other cases, increases in drill and blast costs are required to achieve minimised processing costs,” he said.

“The digital tools, physical products, and drill and blast expertise within Dyno Nobel allow for us to deliver minimised overall operating costs when engaged as a partner with the customer,” he said, adding: “We have seen cost savings ranging from 5-35% at various customers leveraging our solutions.”

In addition to collaborating with customers, DynoConsult’s blasting experts are constantly working on identifying ways to measure performance and key performance indicators by evaluating off-the-shelf new technology and developing its own methodologies and instrumentation for measuring, Lusk said.

“We have some exciting projects related to telemetry, power consumption, fragmentation, and load and haul evaluation that should allow for seamless transition of data to our systems for analytics and decision making.”

Digital developments
BME says it is out to leverage the digital transformation going on in the mining sector and, according to Managing Director, Joe Keenan, has several blasting products that prove this.

He said: “Automation in mines, new analytic capabilities, digital workers and remote operation are just some examples where technologies are disrupting the mining industry today.

“At BME, our turnkey blasting offering is based on our ongoing investment in technology in precisely these fields; combining the power of mobile computing and cloud data storage to enhance safety, productivity and information transparency, allowing quicker and better decision-making.”

He highlighted IoT technologies as an important driver of mine profitability through safe, efficient and automated operations.

“Our AXXIS centralised blasting system, for example, takes the benefits of electronic detonation into the underground environment – with active monitoring and detection that gives mines the ability to take corrective action before a blast instead of just remedial action afterwards,” he said. “The system’s data collection capability provides faster insights and improved blast prediction using advanced analytics and data tools; it also allows data visualisation through dashboards and easier information accessibility.”

In a similar fashion, BME’s XPLOLOG technology monitors the activity and performance of teams conducting drilling, charging and stemming on a blast site – and controls the use of key resources like emulsions, BME says.

“XPLOLOG captures detailed information on each hole, picking up inconsistencies or issues that could reduce the quality of a blast,” Keenan said. “This easy-to-use tool can upload and download data, presenting it on a dashboard for better management decision making – and integrates with our powerful BLASTMAP III design software.”

Driving this work is BME’s Innovation Hub, a
dedicated division that commercialises its technology to benefit customers, the company says. Staffed by physicists, engineers and chemists, it continuously improves various aspects of the company’s offering – “from emulsion formulations and blast modelling, to mobile app technology and data transparency”.

Keenan said: “The landscape of Mining 4.0 is no longer about commodities; rather, the focus is now on embracing technology and evolving as an industry. This means increasing collaboration between mines and their partners; we are constantly being approached by our customers to participate in new mining technologies, so we work increasingly in collaboration with them to find solutions for the industry as a whole.”

No to nitrate
It is not only the vibration and noise that comes with blasting that miners need to be aware of in their environmental efforts; they also need to ensure nitrogen-based explosives do not have an impact on the mine’s surroundings.

Spillage, dissolution in wet holes and incomplete detonation during blasting activities can result in soil and water contamination with nitrates, nitrites and ammonia.

MAXAM’s Huélamo says controlling nitrogen leaching from blasting operations is an important issue for the company and, on top of assisting several mines on ways to control or reduce leaching, it has been progressing processes for this as a lead participant in the Sustainable Low Impact Mining (SLIM) project, under the European Commission’s Horizon 2020 initiative.

The objective of SLIM is to, according to project organisations, “develop a cost-effective and sustainable selective low impact mining solution based on non-linear rock mass fragmentation by blasting models, airborne particulate matter, vibration affections and nitrate leaching mitigation actions for exploitation of small mineral deposits including those with chemically complex ore-forming phases.”

For this purpose, a new generation of explosives and an advanced automatic blast design software will be applied, according to the organisers. This will be based on improved rock mass characterisation and fragmentation models for optimum fragmentation, minimum rock damage and far-field vibrations.

MAXAM has been leading the development of a solution to address the issue of nitrate leaching within this project and, over on a different continent, has been applying this expertise to mine sites.

A recipient of this expertise is Teck, which has been looking to improve water quality in the part of British Columbia’s Elk Valley region it operates in.

Teck was previously using plastic liners to stop the nitrates from explosives interacting with water during the blasting process, but, in order to use plastic liners, blastholes have historically needed to be dewatered so that the liner can reach the bottom of the hole and stay there, the miner said.

“For blastholes that refill with water, a new approach was required,” Teck said.

To tackle this problem, Teck undertook a research project to determine how plastic liners could be used in blastholes that naturally refill with water (often called dynamic blastholes). The research project was led by Teck with support from MAXAM, Teck’s explosives provider, and Friesis Plastics, Teck’s liner supplier. Together, various combinations of procedures, liner types/packages and explosive bulk truck modifications were trialled until a new system was developed.

Teck explained: “The emulsion in a liner system involves using the charging hose on the explosives truck to place the plastic liner in the bottom of a dynamic blasthole. The hole is then loaded with water resistant explosive from the bottom up, both filling the liner and keeping it in place. Once complete, the end result is a lined blasthole with the explosives protected from the water.”

For the plastic liner to be effectively placed down the blasthole, a hydraulic arm and funnel were added to the explosive bulk truck hose and the traditional borehole plastic liners had to be compressed into an accordion shape, according to Teck. The hydraulic arm allows for the hose to be placed directly over the blasthole and the funnel removes the wrinkles from the compressed plastic liner as it unfolds and is pushed to the bottom of the hole. “This ensures consistent lining of every blasthole while meeting our needs of durability and functionality,” the company said.

A common problem identified during early tests was the plastic liner being pulled back up the blasthole as the hose was withdrawn.

To address this, a system was developed that applies mineral oil to the bulk truck hose which acts as a lubricant allowing the hose to be withdrawn while keeping the plastic liner and blast material in the hole, Teck said.

“This process has now been successfully field tested on over 400 holes and has proven to be a safe and effective design,” the company said.

It is currently being piloted at Teck’s Fording River and Greenhills operations, but the plan is to implement the process across all of Teck’s steelmaking coal operations in 2019, the company said.

“As a result, every blasthole in the Elk Valley that is operationally accessible will contain a liner that protects both the explosive product and the environment. This will significantly reduce nitrate at source and help to protect water quality,” Teck said.

Electronic initiation
Dyno Nobel, earlier this year, launched the newest addition to its electronic initiation portfolio, the EZshot®.

This technology offers users the benefits of accurate electronic timing with the ease of use of the NONEL® shock tube – a product designed to initiate explosions – the company says.

“The EZshot detonator series is an exclusive design for underground perimeter blasting. This system gives the customer the ability to use electronic timing for improved perimeter control, helping them to save on time and overall production costs,” Dyno Nobel said.

The electronic detonator, EZshot LP, has a high-strength detonator in a heavy walled copper shell with an electronic circuit board timing chip providing precision and accuracy, according to Dyno Nobel. “The smart chip technology in the detonator delivers the timing needed that cannot be reached with tradition non-electric detonators,” the company said.

The electronic detonator comes in factory-programmed delay times, ranging from 1,100 to
Dyne Nobel says its EZshot detonator offers users the benefits of accurate electronic timing with the ease of use of the NONEL shock tube

8,000 milliseconds, with the long period delay timing ideal for underground perimeter blasting, it says. The EZshot LP shock tube is identical to the NONEL LP shock tube Dyno Nobel has been producing since the 1970s but comes in a new colour.

“This reliable design has stood the test of time and blasters will be familiar with the J-hook connection, virtually eliminating additional training time. EZshot LP takes advantage of the shock tube system allowing wireless communication from initiation to detonation,” the company said.

Dyne Nobel, owned by Australia-based Incitec Pivot Ltd, also recently entered an agreement with Mining3 to “develop and deliver transformational technology to improve the productivity, sustainability, and safety of the mining industry”.

The company plans to leverage its Mining3 membership through the identification of, and collaboration in, the development of new technologies important to the industry.

Wayne Stange, Dyno Nobel’s Vice President of Mining Technology, said: “There are several Mining3 projects that are aligned with our technology development initiatives. Through our Mining3 membership, we will be able to work with a range of researchers and mining equipment and technology services to accelerate the development of transformational technology.”

One project Mining3 is working on that will probably interest Dyno Nobel is the pursuit of a non-toxic post-blast bulk alternative explosive.

**Blasting rebrand and expansion**

**AEL Mining Services** (AEL), a member of the JSE-listed AECI Group in South Africa, recently announced its official rebrand to AEL Intelligent Blasting.

This move is in line with the organisation’s renewed vision of embracing the technological revolution in the explosives and mining industry, it said.

Edwin Ludick, Managing Director at AEL

**IM:** Since launching smartblast, has the company won more orders from the underground mining or surface mining sector?

**BV:** We have won considerably more orders from the underground mining sector as we do specialise in underground mining communications. Since the mines were already installing an underground communication system and the smartblast system runs over the communications network, the smartblast system was the logical choice for a number of mines.

**IM:** There are now many remote firing devices available to the mining industry; how has Becker Varis continued to differentiate its own smartblast system from other similar products?

**BV:** We rely heavily on feedback from the end users and we are constantly gathering information and talking to customers about their needs and possible product improvements. There is continuous work being done on upgraded designs. The latest being the smartblast 1673 series which has a controller unit that can initiate up 64 remotes. Whereas the previous 1670 series could only initiate eight remote units for each controller. This is especially beneficial for the larger mines that had a requirement for up to 32 remote units in the field which, in the past, required them to have four controllers.

Another feature unique to the 1673 series was the addition of post-blast motion detection. Many of the underground mines using the smartblast system to initiate their blast from surface could not always easily tell if the blast had gone off and requested some kind of feedback from the system. With the addition of the motion detector, the user gets immediate post-blast acknowledgement of successful blast initiation. Other added features in the 1673 series include a history event log, increased firing capacity, GPS fencing, among others.

**IM:** What type of mine applications are the ‘sweetspot’ for smartblast?

**BV:** I would say that there isn’t really a ‘sweetspot’; we have smartblast systems installed in all sizes of mines. It all depends on the mine itself and how they distribute their communication networks. In most cases, it is an easy choice to go with smartblast because they will already have the radio communications infrastructure in place which the smartblast system uses as a backbone. This way you only need to maintain one cable system, which will provide both two-way radio communications and remote central blasting, with the possibility to add other data transmissions as well. With the reduced maintenance and less missed blasts, the system can pay itself off within a year.

**IM:** How does Becker Varis expect its blasting portfolio to impact the use of smartblast?

**BV:** At this stage in the evolution it has not impacted the use of smartblast much, but with integrations of Wi-Fi and LTE in mines now, smartblast will have to follow suit, which is part of the development of the product.

**IM:** Are there any recent Smartblast case studies you can mention where the product has achieved impressive results?

**BV:** I can’t give a specific case study, but all smartblast installations have improved overall safety and can save the mine approximately $100,000/y in operation and maintenance costs.

**IM:** How does Becker Varis expect its blasting portfolio to evolve in the next five years?

**BV:** Now that the 1673 series is picking up, we need to concentrate on the new communication networks to ensure the smartblast system can run on all available networks.
Mining Services, said: “Our new branding seeks to capitalise on our successful growth and expansion, and supports our strategy to position the group as the most intelligent choice in the market when it comes to blasting services and products.”

“Innovation is key to ensuring continuing market relevance and customer satisfaction,” Ludick said. “Our rebrand is aligned with our mission to keep our global operations on the frontier of technology through the delivery of ground-breaking innovations; to offer state-of-the-art technological solutions to our clients; and to operate sustainably, without harm to people, the environment and the communities in which we operate.”

To meet the changing needs and challenges of the mining industry, AEL operates on the ideal of partnering with its stakeholders and customers to realise the products and services they require to take the mining industry into the era of digitalisation and smart mining, the company says.

“By partnering with our customers on their unique journey, we are able to ensure efficient and sustainable blasting practices by focusing on optimal blast outcomes, optimising blasting processes and solving blasting problems,” Ludick said.

To this end, the holistic and flexible AEL intelliBlast™ value proposition enables the strategic combination of a comprehensive range of services and product offerings, tailored to proactively develop smart blasting solutions for optimal mining outcomes, AEL said.

In addition, the exclusive contribution that AEL’s intelliBlast offers the market is a “fundamental component” in the business’ global expansion strategy. AEL Mining Services’ leading technology is already being used in Australia, South America and various locations in the rest of Africa.

This in itself has various benefits to customers such as reductions in blasting delays and improved uniformity of fragmentation, while ensuring uncompromised safety at all times, the company said.

“We are continuously evolving and developing and the rebrand supports this. All these efforts are underpinned by engaging with our customers to really understand their needs and to develop a solution central to those needs. Once we agree on the solution it’s a very good example of creating good chemistry and great energy,” Ludick concluded.

AECI expanded its international presence this year, concluding a $6.3 million deal to acquire, through its subsidiary, AECI Latam Produtos Quimicos Ltd, an explosives business in Lorena, Brazil from Dinacon.

The transaction, which was implemented through a judicial recovery process, has been finalised and is expected to take effect in the September quarter of 2019. Dinacon Lorena will then be rebranded as AEL, as trading will start under the AECI Group of Company’s Latin America (Latam) banner.

The purchase included ownership of an explosives manufacturing plant, distribution and storage facilities and the requisite explosives operating licences, AECI said.

“The acquisition provides an opportunity for entry into the explosives market in Brazil and the rest of Latin America, in line with the group’s intent to continue expanding the geographic footprint of its Mining Solutions strategic growth pillar,” AECI said.

In the past, Dinacon has supplied explosives mainly to the Brazil civil and construction industry, with its business in the local mining sector limited, according to AECI.

“Brazil has more than 8,000 mines, so there is a sizeable opportunity for growth, particularly in terms of leveraging AEL’s significant experience in open-pit and underground mining; its African, Australian and Indonesian footprint; and its long-standing relationships with international mining companies,” AECI said.

AEL Brazil Managing Director, Carlos Goncalves, said: “It is the first of its kind for AEL in Latin America and represents an ideal platform to grow the AECI Group’s Mining Solutions business in the rest of the region.”

AEL, meanwhile, has successfully conducted and completed trials during which its explosives, initiating systems capabilities and expertise were evaluated at selected South America mining operations. The trials were done as part of an extensive qualification process that began in 2017, which larger mining companies require of explosives suppliers.

Owing to the successful trials, the company was invited to participate in several tenders for these mining operations, with the bidding process having started in December 2018.

“The qualification of AEL as being a reputable explosives company with the necessary knowhow and complete product and service offering has been a critical milestone to achieve among the larger mining houses in the Latin America region,” Goncalves said.

**Charged up**

EPC-UK, a market leader within the UK commercial explosives and blasting services sector for mining and quarrying, in March, opened its new bulk emulsion facility at the company’s Rough Close Works site in Derbyshire.

Designed to deliver the necessary infrastructure required to enhance the safety of the company’s emulsion manufacturing process, the new site – a result of the company’s biggest investment in 25 years – was formally unveiled by Olivier Obst, Chairman and CEO of the EPC Groupe.

The bulk emulsion, otherwise known as ammonium nitrate blasting intermediate (ANIB), is the primary raw material in EPC-UK’s Blendex range of site-mixed bulk explosives and is used by the company’s ‘Rock-on-Ground’ service teams, as well as by its direct supply customers.

The new facility was created by adapting existing buildings to enable EPC-UK to house the process equipment and raw material storage vessels. Two new structures accommodate an ammonium nitrate silo, used at the beginning of the process, and a final product silo at the other. A new steam and condensate line have also been installed.
EPC Groupe devised a fully automated remote control up-hole pumping system that comprised an automated crane arm and a specially designed hose pushing system to solve the complex blasting requirements of Mandalay’s Björkdal gold mine, in Sweden.

Chris Barlow, Operations Manager at EPC-UK’s Rough Close Works operation, said: “Not only is it (the plant) allowing us to ensure stringent safety standards are adhered to, it is also enabling us to create a manufacturing process that is more efficient in terms of energy usage, reducing the company’s carbon footprint and production costs, whilst having the flexibility to vary production rates.”

Over in Sweden at the Björkdal gold mine, EPC Groupe has faced an altogether different task to building a new bulk emulsion facility.

Owned and managed by Mandalay Resources Corp, Björkdal is around 28 km northwest of Skellefteå, itself near the historic Boliden mining district.

The mine, which uses 60 t/mth of emulsion, produces 800,000 t/y of gold-bearing ore from a combined open pit and underground operation. Around 60% of this feed comes from underground.

Mineralisation at the mine is typified by gold-quartz hosted veins, which are vertical to sub-vertical and strike between 40-55°. These veins vary in width between a few centimetres to over two metres, with the veining locally complex, with many cross-cutting thin veins.

“This unique geology, with its constantly changing drifts combined with the harsh climatic conditions of northern Sweden, make mining the area a continuous challenge,” EPC Groupe said.

“Since the mine opened, its operators have continually looked at ways to improve the effectiveness and precision of their blasting processes and have explored ways to create an even safer working environment for employees.”

To meet these objectives, the gold mine approached EPC Groupe, back in 2013, to solve its blasting issues.

Björkdal uses the long hole stoping blasting method – a technique considered highly selective and productive – however this selection presented a number of challenges: first, the vertical nature of the mine’s holes created a need to provide an explosive that would remain stationary during the blasting process and, secondly, 30 m up-hole charging needed to be maintained, in addition to standard horizontal hole charging, during a continuous mining process.

EPC Groupe said it, first, addressed the need for a tailored emulsion formula, looking at the thickness and density required for the explosive to stick reliably in the holes. This led to the creation of an explosive blend with an extremely high viscosity level that could adhere effectively to the side of the vertical holes, the company said.

To tackle the issue of maintaining 30 m up-hole charging during a continuous mining process, the EPC team researched several solutions, settling on a fully automated remote control up-hole pumping system that comprised an automated crane arm and a specially designed hose pushing system. Both were remotely controlled and linked to a PLC.

“The result provided a clear and visible PLC data and see a 3D model of the drilling and production rates. The result provided a clear and visible PLC data and see a 3D model of the drilling and productive – however this selection presented a number of challenges: first, the vertical nature of the mine’s holes created a need to provide an explosive that would remain stationary during the blasting process and, secondly, 30 m up-hole charging needed to be maintained, in addition to standard horizontal hole charging, during a continuous mining process.

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“The result provided a clear and visible PLC control of the hydraulic functions, which made calibration easier and provided an accurate feed and smart retraction for the charging hose,” EPC said. “Additionally, by adding a probe to the end of the hose, the system could also be used for borehole deviation measurement and provide precise information to help remove potential uncertainties during a blast.”

During the transition, the penetration depth of the holes created was constantly measured, allowing operators to customise charging on a hole-by-hole basis. “Although not new to the industry, the use of this hole depth measurement technology in mining underground stopes is unusual, but it is being used with great success at Björkdal,” EPC said. Alongside the automated crane arm and specially designed hose pushing system, the technicians at EPC developed a detonator box able to directly integrate into the system and compartments according to different delays.

“This enables operators to save precious time during charging operations,” the company said.

“As well as improving blast precision and effectiveness, the newly developed technology has also helped to enhance safety for operators,” EPC said. “As it is remotely controlled and linked to a PLC, operators can easily pilot the movement of the crane arm and insert the hose into different boreholes in a very flexible way. The technology also negates the need for operators to stand directly underneath the holes. They can now position themselves clear of the blasting location, which provides a global view of the drift ceiling and makes the entire process much safer.”

Underpinning the new up-hole pumping system was EPC Groupe’s EXPERTIR blasting software. EXPERTIR allows the integration of 3D profiles from the likes of laser, drone, or digital photogrammetry, using this geometrical data to model holes, including tilt and depth, so that drilling can be completed accurately.

The company said: “EPC worked closely with the operators of Björkdal gold mine to create a specific version of EXPERTIR that would address the mine’s particular needs. The result is EXPERTIR UG (Under Ground) – a software program that allows an operator to create a full 3D model of the drift being blasted and to assess key performance indicators, such as contour quality.

“Millions of points are taken into consideration using a 3D laser or photogrammetry method, to provide precise and comprehensive results. Moreover, the software allows the user to process borehole deviation data and see a 3D model of the drilling and blasting geology.”

EXPERTIR UG has now been integrated into Björkdal’s existing applications, which include GPS-based devices that track details such as muck pile movement and ore dilution, to create an “entirely transparent, cohesive system”. 