

Nordic technology and expertise continue to be valued on a domestic and international level, with the sustainability agenda only strengthening demand for these solutions, Dan Gleeson reports

Built to last

From mobile equipment, to mineral processing, to networks and communications, to drilling consumables, the Nordic METS sector is an established global brand in its own right.

This expertise has been developed and tested over time in some of the harshest conditions the global mining sector offers – some of the hardest rock, some of the most complex orebodies, some of the coldest temperatures and some of the most remote operations.

The thinking goes: if equipment and solutions work at mines in the Nordic region in the heart of winter, they will be able to deal with any conditions they may face operating across the world.

Bits that bite

Finland-based Robit and its drill bits are a case in point.

The company's products are used worldwide after being developed in the challenging rock



The new Robit Superior Rbit Button Bit Series achieves faster rates of penetration and the lowest cost-per-metre, Robit says

conditions of Scandinavia.

It has recently taken up the task of making its drill bits even better and more environmentally friendly by introducing a new button bit series manufactured with recycled steel.

The new Robit Superior Rbit™ Button Bit Series achieves faster rates of penetration and the lowest cost-per-metre, according to the company.

In line with Robit's sustainable manufacturing process, the Rbit is manufactured on fully automated production lines and finished with "eco-friendly" water-based paint, Robit says.

Coming in two models – the Flat Face and Drop Center – the new bits are designed with state-of-the-art computer fluid dynamics simulation, with global field tests demonstrating "clear evidence" of a superior drilling performance, it added.

They feature an optimised button layout configuration on the Flat Face model to ensure maximum rock contact and energy transmission; a new transition face developed in both models to improve percussive energy transfer into the rock; an enhanced flushing design for an even faster rate of penetration; redesigned wider retrac grooves to allow more space and deliver a better flow for the cuttings; and optional heavy-duty models.

Robit says its partner drillers were happy with the performance and noted better flushing and longer grinding intervals with the new Rbit drill bits.

Completing the automation loop

Still in the realm of drilling and Finland, IMA Engineering is aiming to complete the automation cycle in blasthole and rotary drilling by providing autonomous sampling and analysis solutions that can be retrofitted to any manufacturer's drill rig.

Automating the sampling and analysis process when carrying out drilling allows miners, at the most basic level, to know where the ore and waste is coming from within the drill hole itself

As Ilpo Auranen, Chairman of IMA, says, autonomous drilling operations have been an option for companies in the most established mining regions for more than a half decade. Despite the established nature of the technology, no miners or OEMs to date have looked to complete the automation loop with a robotised sampling and analysis system.

"They have forgotten they need samples in this process," he told IMA. "Why have they forgot this? It is because the big drilling OEMs are not in the sampling business. They are selling the idea that automation can save you significant cents per tonne on your operating costs, but if you are not carrying out accurate sampling to find out just what you are drilling – and subsequently blasting – you are not increasing the value of your operations."

While conventional sampling and analysis processes would see personnel approach the mining bench to collect a sample only when it safe to do so and send the sample off to the lab for analysis, what IMA and Auranen are proposing is a lot safer, efficient and, Auranen argues, accurate.

IMA provides the whole automated sampling and analysis solution in this drilling context, for any type of blasthole or reverse circulation drill rigs, with its IMA Blasthole Sampler Analyzers (BSAs). These units consist of a sampling system with conveyor and hopper and an on-line X-ray Fluorescence (XRF) analyser that continuously measures the ore grade and value as material is fed past it. The drilling process is not held up by personnel needing to step onto the bench – a potential safety hazard – and the sampling and analysis comes with the improved accuracy of constant analysis, compared favourably with gathering a fraction of the cuttings after drilling is complete for the lab to check over.

"There are two basic differences depending on the drill cutting handling system on the drills," Auranen said of the BSA system. "On down-the-hole and top hammer rigs, the cuttings are typically sucked from the hole collar to a cyclone where they drop on the ground. There we collect all the cuttings from that system continuously for analysis."

"In large rotary-type blasthole drills, the drill cuttings normally stay around the hole collar, creating a cuttings cone. Only the fine dust is sucked to the dust collection system, or rather you put water in the hole to prevent the dust flying around. In those applications, we have a sampling conveyor extended to the collar of the hole and 10-20% of the cuttings land on the conveyor and are transported to the analyser."

The “trick” with both systems is that, as the system is continuously analysing, it does not matter how much cuttings are being conveyed on the belt towards the XRF unit. With dense on-line analysis from the holes, it is still possible to calculate an accurate 3D grade control map of the blast bench, according to the company.

When integrated with GPS systems on new drills, the drill hole, sample and rig can all be tracked back to an exact location, according to Auranen. This is especially important for mines monitored from remote operations centre.

Automating the sampling and analysis process allows miners, at the most basic level, to know where the ore and waste is coming from within the drill hole itself. Companies are then free to use this data as they see fit.

One option is to, post-blast, accurately assign the waste and ore piles to the loading and haulage team. Another option is to adjust the amount of explosives inside the hole based on the location of the ore and waste – more explosives for the ore and less for the waste in the majority of operations. A third is to use timed blasting to ensure the waste rock and ore fly in different directions for definitive separation.

More uses of this data are bound to arise when the first use cases are established, which Auranen is hopeful are not too far away.

“We have tested the system in large rotary rigs and down-the-hole rigs in real world mines,” he said. “This has seen it operate in conditions from -30°C to +54°C.

“With a commercial product now established and discussions with miners ongoing, we could install a system in six months from an order.”

Auranen was happy to provide an update on its XRF ore sorting efforts when in conversation with *IM* too.

Referencing its latest pilot project in open pit and underground mines with its IMA XRF-Bucket Scanner – which sees a sensor solution positioned at a specific location where LHDs and wheel loaders can check the grades of their bucket loads by positioning said bucket underneath the sensor – Auranen said the company is now incorporating RFID tags into the equation to achieve close to real-time ore tracking.

“We have a system where we put RFID marker tags in the ore to understand where that ore originally came from – from the blast hole in the mining bench or the stope – then we use tag readers to read the tags travelling with the ore, first, on the conveyor belt using an IMA XRF analyser after primary crushing to connect the analysis results with the tag and, second, at the destination on the concentrator feed belt,” he said.

The first benefit is immediate feedback to



mining operators of the ore grade. This data is combined with the concentrator results and reconciled with the mine’s block model to, Auranen says, increase the efficiency of mining, reduce waste rock dilution and ore losses, and act as a quality control and quality assurance (QA/QC) tool between the mine and concentrator.

“In these trials, we have noticed that some 10-15% of mill feed going to the concentrator is below the cut-off grade,” he said. “Of course, this is not zero grade material, but the financial impact is very big. We are talking about \$40-50 million a year with some of the larger mines.”

There is an argument for using the IMA sensors with IMA BOSS bulk ore sorting systems and an RFID tagging system for separating clean waste from acid forming waste when placed in waste piles, potentially tracking future revenue sources (dependent on commodity prices and technology) and eradicating the risks associated with acid rock drainage, Auranen added.

Wireless blasting

IMA has previously carried out an ore sorting report for Outokumpu’s Kemi chromite mine, in Finland, as part of an Oulu Mining School-backed study, and this underground mine continues to act as a testbed for new innovations.

One such innovation is wireless blasting where the mine, together with blasting and explosives specialist **Forcit**, recently introduced centralised wireless blasting via Wi-Fi using Davey Bickford Enaex technology. Forcit, with its partner Davey Bickford Enaex and Kemi Mine, co-operated to implement the DaveyTronic®UG system to ensure safe and economical blasting at the underground operation, it said.

The centralised blasting system enables controlled implementation of blasts using the Wi-Fi network of the mine. No personnel need to be present in the mine during the blast because

Forcit, with its partner Davey Bickford Enaex and Kemi Mine, co-operated to implement the DaveyTronic®UG system to ensure safe and economical blasting at the chromite operation

all fields in one blasting window are fired from a centralised blasting place in a controlled manner.

The system also enables the ignition of fields using non-electronic detonators and fields using electronic detonators in the same blasting window. Non-electronic detonator fields are ignited using an electronic detonator via the DaveyTronicUG system.

“DaveyTronicUG enables two-way communication with all blasting fields up to the moment they are blasted, which increases quality and safety,” Forcit said. “It is possible to implement the whole procedure with just a push of a button, in which case all fields are verified and charged to be ready for a blast. The actual blast can be done automatically, field by field, at pre-agreed intervals or, if wanted, manually, field by field.”

Arto Palokangas, Production Engineer at Kemi mine, says the new system will first and foremost increase safety.

“To carry out the blasts in one blasting window nowadays several groups of blasters have to move to several locations in the mine in a pre-agreed order in a short window of time,” he said. “With the DaveyTronicUG system, blasting can be carried out centrally from a single location when the mine is empty. In the future, centralised blasting will also enable the shortening of the blasting window and, this way, increase the efficiency of working time.”

The commissioning of the system and training of the staff were implemented towards the end of 2020. The training covered several topics: the commissioning of the devices, attaching the devices to the mine’s Wi-Fi network and training blasters to use the system.

At the beginning of 2021, the system has

become an even more significant part of everyday life at the mine, with the aim that all blasts will be executed from one place in a controlled, effective and safe manner, according to Forcit.

Underground communications

A reliable communications backbone is of the utmost importance to get such a wireless blasting system operating effectively, with mines all over the globe tapping network experts to install such a platform.

As part of the contract supporting EVRAZ's digital transformation program at the Sheregheskaya underground iron ore mine in south-central Russia, **Ericsson** and Mobile TeleSystems PJSC (MTS) are deploying a commercial LTE/5G-ready private network built on the Ericsson Dedicated Networks solution.

The Sheregheskaya mine is a pilot area for EVRAZ's digital transformation program, which began in 2020. The program is geared towards introducing modern digital technologies to increase industrial safety, boost equipment efficiency and improve production.

Set to be integrated with the mine's existing communications network and IT infrastructure, the wireless dedicated network provided by Ericsson and MTS will be the first stage in the transformation program, according to Ericsson.

The solution – which will include a system for voice radio communications, video broadcasting, emergency notifications, dispatching, positioning and autonomous control of mining equipment – will feature carrier-grade Ericsson Enterprise Core and Ericsson Radio System Micro nodes, providing the level of connectivity needed to enable smart capabilities for the next generation of mining, it added.

The network “will lay the foundation for a seamless upgrade to 5G in the future without requiring significant changes in its architecture”, Ericsson said. “This will ensure fast migration to 5G without interruption.”

This is not the only Russia-based mining operation looking into 5G.

MTS and Polymetal International, in November, announced plans to deploy Russia's first commercial 5G-ready private network – based on Ericsson's Dedicated Networks solution – at the Nezhdaninskoye gold mine in Yakutia.

JSC South-Verkhoyansk Mining Company, a Polymetal affiliate, plans to leverage the MTS-deployed network for integrated connectivity across IP-telephony, mobile devices, mine dispatch systems, remote and automated equipment control – including for excavators, drill rigs and measuring devices – as well as automated fire extinguishing systems and video monitoring.

The Ericsson Dedicated Networks solution complies with the 3GPP standards and includes a full-fledged carrier-grade network core, Ericsson says. It supports 4G and 5G Non-Standalone simultaneously and allows dual-mode core capability to support 5G New Radio Standalone.

Not to be left behind, Sweden-based **Telia** is to build and manage a dedicated local 5G-ready mobile network for mining company Boliden at the Aitik open-pit copper mine, in the north of Sweden.

Over time, the new mobile network will be used to monitor and control machines in the mine, with the aim of improving productivity, the working environment and operational safety.

Telia will deliver a complete solution to Boliden with both radio network and core network and is responsible for continuous management and development of the solution. The solution is based on the latest 4G-technology from Ericsson and can be upgraded to 5G over time, according to Telia.

Telia and Boliden, together with partners like Ericsson, have a long-standing partnership to explore digitalisation in mining and were the first in the world to launch an underground 5G-network in a mine, Telia said.

To allow for flexibility in the operations, Telia will deploy a mobile base station at Aitik. Boliden can also choose to add new services to its dedicated mobile network, like small 5G dots to enhance indoor coverage or walkie-talkie functionality in its mobile phones to enhance communication between workers in the mine. The solution Telia delivers to Boliden is based on the service Enterprise Mobile Network, EMN.

Still in Sweden, the Lundin Mining-owned Zingkrivan zinc mine recently embarked on a trial of tele-remote drilling using a 4G LTE network supplied by Telia as part of the miner's shift towards autonomous operation.

Zingkrivan Mining was the first operation in Sweden to install an LTE network underground, it claims, and has become the first company in the world to leverage this LTE network to carry out tele-remote drilling of an Epiroc Simba E7C top hammer drill rig.

The test has seen operators control the rigs, positioned around 650 m underground, from an above-ground station on site.

A collaboration between Zingkrivan, Epiroc and Telia, the project has used a previously installed network at the mine to re-start drilling soon after blasting concludes, while removing the lost production that can come with shift changeover.

Bring in the reinforcement

At another one of the Nordic region's innovation testbeds, Sweden-based **Bergteamet AB** is

showcasing its varied contract mining expertise.

As early as 2008, Bergteamet appointed a group of operators to focus on dynamic rock reinforcement for underground mines and tunnels. Since then, it has mounted almost 800,000 mesh bolts and 150,000 wire bolts.

Back in April 2020, it kicked off a project with LKAB at the Malmberget iron ore mine that includes dynamic reinforcement, mesh and wire reinforcement.

“As far as I know, we were among the first in Sweden to use this reinforcement method,” Mats Ragnarsson, Bergteamet's Site Manager in Malmberget, said of the company's dynamic rock reinforcement with mesh strategy. This method, the company says, provides better protection than traditional reinforcement, with the mesh and bolts taking up the so-called “dynamic loads” and “capture movements” in connection with seismic events and settlements.

In this scenario, the mesh is used to catch rock outcrops so no rockfalls occur.

The dynamic rock reinforcement is mainly used at deeper mine levels where the rock pressure is higher and the risk of rock falls is greater.

The dynamic bolts come with in-built flexibility unlike traditional bolts with treaded rebar that are static, Bergteamet says. The dynamic rock reinforcement option can also be supplemented with a wire bolt, where, if a seismic event occurs, the bolt's pressed anchors are activated, enabling the bolt to stretch considerably before it breaks off.

When the reinforcement is carried out, a concrete layer is first sprayed on the tunnel areas, then bolts and mesh are placed on top of the concrete. The traditional bolt pattern usually has a crack control distance of 1.5 m or 2 m. When mesh is set, the bolt pattern is typically one meter. The work is carried out mechanically with a rig that can drill, bolt and is equipped with a mesh arm such as Epiroc's Boltec, Bergteamet says.

Ragnarsson said: “Dynamic rock reinforcement provides a safer solution in every way, even if the installation takes a little longer. Another advantage is that the mesh and bolts cooperate with each other when they are mounted and take up loads together.”

Electrified hole charging

Finland-based mining utility vehicle major, **Normet**, is continuing to electrify parts of the underground mining process across the globe after cementing the business case for its Smart Drive vehicles at the Pyhäsalmi mine in Finland.

Its Charmec MC 605 VE Smart Drive battery-powered emulsion charger is continuing its tour of Australia, with Barmenco having recently signed up to trial the machine for three months



Barminco recently signed up to trial Normet's Charmec MC 605 VE Smart Drive battery-powered emulsion charger at the Independence Group-owned Nova nickel-copper-cobalt underground mine in Western Australia

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Barminco, a Perenti company, says the trial is part of its commitment to improving performance and driving sustainability initiatives across its business.

The MC605 VE Smart Drive will be a direct

replacement for the diesel-powered MC605 D Barminco uses at its underground client sites, with the battery-electric trial likely involving a mix of production and development operations.

“Along with the maintenance and cost benefits of using battery-electric equipment underground, it will also provide an improved work environment for our people,” Barminco said.

OZ Minerals, in October, became the first miner in Australia to take delivery of a battery-powered Normet Charmec MC 605 VE SD. The charging unit, which arrived at the Carrapateena

copper-gold mine in South Australia, was also put through a three-month trial.

Back in 2019, Normet made history with the MC 605 VE SD by demonstrating battery-electric emulsion charging in an underground production environment for the first time in Europe at Pyhäsalmi.

Sustainable solutions

Looking to showcase their own sustainability leadership in the mineral processing and mobile mining equipment spaces, Metso Outotec, Sandvik and Epiroc are all refining their product lines to help reduce the amount of greenhouse gas emissions associated with operating their products.

Metso Outotec has recently introduced a new approach to sustainability that, it says, covers the environmental, social and financial aspects of the topic area.

Its ‘Planet Positive’ efforts enforce the company’s purpose to enable sustainable modern life, building on its commitments to limit global warming to 1.5°C, with targets validated by the Science Based Targets initiative, Metso Outotec said.

The Planet Positive portfolio focuses on the most environmentally efficient technologies – of which there are more than 100 – in the company’s current portfolio, responding to the sustainability requirements of its customers in the aggregates, mining and metals refining



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industries. In comminution, this includes energy-saving technologies like high pressure grinding rolls – its HRC – and stirred mills.

Over 90% of the company's product development projects also have sustainability targets today.

Sandvik, meanwhile, made progress in 2020 on achieving its sustainability target of halving its CO₂ impact by 2030, compared with its 2018 base case.

Its Mining and Rock Solutions division launched the world's first 18 t battery-electric loader, the LH518B, which reduces heat and emissions underground, helping mines reach their sustainability targets and reduce ventilation costs. The first of these commercial vehicles is now operating at New Gold's New Afton gold-copper mine in British Columbia, Canada. Meanwhile, it continued to recycle cemented carbide for rock tools, reducing both energy consumption and CO₂ emissions compared with using virgin materials.

In crushing and screening, which comes under the Sandvik Rock Processing Solutions business, it recycles 90% of its wear parts. This is also the case for its newest "plug-and-play" jaw crushers, launched in late-March.

Epiroc has been similarly ambitious with its sustainability targets, looking to, by 2030, halve CO₂ emissions generated from machines sold compared with machines sold in 2019.

Already one of the leaders in battery-electric vehicle development, the company has recently announced the development of a 'next generation' Boomer face drill that comes with a battery-electric drivetrain option, plus acquired Canada-based Meglab as part of its mine electrification push.

Smart Site gets smarter

Electrification, automation and digitalisation are key focus areas for engineering, consulting and design company AFRY.

The Sweden-based company recently expanded its digital offering for process industries with the acquisition of ProTAK, whereby ProTAK's web-based software for production optimisation will support AFRY's strategic ambition within digitalisation and sustainability, as well as further strengthen the AFRY Smart Site digital product portfolio further, it said.

"ProTAK's web-based software is designed for production process continuous improvement and aims to increase production efficiency," AFRY explained. "The software measures the effectiveness of industrial plant's machines to enable analysis and optimisation of the production processes. Together with AFRY's production support software, AFRY Pulse, this will improve process industry customer

C.C.JENSEN says its off-line oil filters are helping miners reduce downtime through the removal of small harmful particles that contribute to wear and tear and, ultimately, system failure



production even further."

The acquisition follows the purchase of ITE Østerhus AS, a Norway-based company that specialises in electrical engineering, automation and digitalisation for industrial customers. ITE Østerhus' largest market areas are smelting plants and process and food industries.

Going off-line for oil filtration

C.C.JENSEN says its off-line oil filters are helping miners reduce downtime through the removal of small harmful particles that contribute to wear and tear and, ultimately, system failure.

As the company says, sudden crusher shutdowns caused by component failure cost both time and money, with dirty or contaminated oil often the cause of these failures.

Traditionally, the answer has been to schedule preventive maintenance in order to change the oil and replace components before they fail. In this way, the need for unscheduled maintenance is reduced, the company says.

"But even scheduled maintenance still means downtime?" it explained. "And downtime comes at a cost, as does the premature replacement of components that still have useful life remaining. Not to mention the oil being changed more often than necessary."

The answer, C.C.JENSEN says, is to reduce the wear on components instead of having to replace them so often. This is where off-line oil filtration and the company's CJC® Offline oil filter comes in.

How clean is the crusher lube oil?

With crushers being sited in very dirty and dusty environments, the oil easily gets contaminated with particles. Traditional in-line filters can process the oil in a crusher in a matter of minutes, but the particles they can filter are, in many cases, larger than the narrow clearances within the machinery. This means smaller particles are free to circulate and cause costly damage to pumps, gears, bearings, etc.

There is a way to remove those smaller harmful, micron-sized particles, which

contribute to wear and tear and ultimately system failure, the company says.

CJC Offline Oil Filtration

An off-line oil filter can catch even the smallest particles, resulting in much cleaner oil without the presence of micron-sized particles that cause expensive wear and downtime. The finer filtration also reduces

the risk of the oil degrading prematurely.

"It's that degradation which all too often leads to oil-related component failures and, as a consequence, expensive downtime while the parts are replaced," the company says. "And it doesn't matter whether that downtime is due to sudden failure or to preventive replacement in an attempt to avoid such failure. Downtime simply means lost production, regardless of the underlying reason."

Off-line oil filtration is a much finer filtration process removing even the smallest micron-sized and harmful particles, as well as water from oil.

The result is significantly less wear on mechanical spare parts, thus extending their life as well as reducing the overall consumption of oil. In fact, the application of a CJC Oil Filter can, the company says, eliminate three of four shutdowns, extend oil lifetime by a factor of four and reduce spare parts consumption by up to 60%.

The effect on the bottom line is easy to calculate, as indicated with two examples.

A copper mine in Chile went from bi-monthly scheduled oil changes to a single, annual oil-related shutdown, for an 87% reduction in downtime, resulting in savings of almost \$500,000/y before considering the savings on replacement parts.

Another copper mine saw cost savings of 86% in oil consumption, 73% savings of in-line filters and 62% savings in mechanical spare parts, resulting in total cost savings of €23,724 (\$28,250) – approximately two thirds of the previous costs.

"Economic benefits are not the only reason to install off-line oil filtration," the company says. "There are also environmental benefits to be gained."

As the oil needs to be changed much less frequently, there is a reduction in the amount of waste oil to be disposed of, and less new oil is needed. All in all, this has a positive impact on the overall environmental footprint. 