*An operator using radio remote control for an Epiroc Mobile Miner 22H in an underground mine*

# New directions for hard-rock cutting

Mining equipment manufacturers and research facilities are working to improve and innovate hard-rock cutting machines, finds Jax Jacobsen

OEMs and researchers are reimagining what hard-rock cutting equipment can do. This is to meet the demands of mining companies that are confronted with the challenges of having to dig deeper to find deposits while also embracing sustainable practices.

Epiroc's newest versions of its Mobile Miner technology include the 22H model, a rock excavation machine which promises higher productivity and better access to hard-to-reach areas in underground mining locations. This machine features horizontal placement of the cutter head, which allows it to dig tunnels as low as 2.2m.

Another model, the Mobile Miner 55V, is intended for use in large access tunnels and comes with several top-of-the-line automation features, such as remote monitoring and control, laser navigation and automatic rock cutting of the face.

"As the mines go deeper and deeper, there are a number of challenging engineering issues when mining deeper and deeper" that pop up, Epiroc's business line manager for mechanical rock excavation Marcus Eklind says. "Using continuous mechanical cutting means these challenges can be addressed in a safer and highly productive way."

The ability to run the machine continuously, without needing to schedule for a cyclic operation, makes it much easier for mining operators to "schedule with one machine, than with several different types of machines," Eklind says.

The benefits of mechanical rock cutting, as opposed to drill and blast, are that it is more cost competitive and more environmentally friendly, Eklind says. It has high utilisation and offers advance rates almost twice that what we see in average mines today. The Mobile Miner offers the advantage of a very exact cutting profile. This selective mining technique results in no overbreak or underbreak, and for narrow-vein and low-seam mining this means that ore can be extracted with little or no dilution.

All Mobile Miner equipment is electric, which means no greenhouse gases are emitted. It also means mining companies will have a reduced demand for mine shaft ventilation, as less heat is generated than from diesel equipment and no blast fumes are created.

The machine is not meant to replace drill and blast, however.

"We should look at mechanical excavation as a complement to drill and blast," Eklind says. "Depending on the mining method, mechanical excavation can be more suitable than drill and blast, both in the production and the development phases, in particular its suitable for narrow-vein and low-seam mining."

## OTHER APPROACHES

Other companies have embraced a different approach: using an actuated disc cutting (ADC) method. Companies using this ADC technology include Komatsu, with its Dynacut line, and Sandvik, in its MN220 equipment.

ADC combines the advantages of roller cutters by decreasing the rate of wear on the discs, and the advantages of drag picks which require lower cutting forces, says Dr Sevda Dehkhoda, a researcher at Australia's CSIRO research agency. ►

**"ADC combines the advantages of roller cutters and drag picks"**

*An overview of Wobble, an ADC test-unit.* *Photo: Dr Sevda Dehkhoda*

"It uses disc-shaped cutters that attacks the rock using an undercutting mechanism," she explains. "It has an additional mechanism that forces off-centric revolution of the disc cutter around a secondary axis, as it is linearly dragged along the rock surface."

This technology allows a significant reduction in the thrusting force of the machine. Wear is also reduced by distributing the friction heat generated from cutter-rock contact by allowing the cutter to roll.

Like Epiroc's technology, ADCs remove the need for diesel engines, making the technology both cost-cutting and environmentally friendly.

"Also, fragmentation products of an ADC unit won't require primary crushing, and can feed into a secondary crusher directly," Dehkhoda says.

CSIRO has also been working on SmartCut technology. According to CSIRO's Dr Xing Li, this allows the conventional tungsten carbides in cutting tips to be replaced with a thermally stable diamond composite, attaching the cutting tip to the cutting tool and using drum design software to optimise the arrangement of the cutting tools on a drum.

This technology works to reduce the operating costs in mechanical excavation of hard rock, while improving productivity. It also specialises in operating in difficult narrow-vein mines and can work under high temperatures while reducing the need for cooling fluids.

## COLLABORATION

Another Australian mine research organisation, Mining3, announced March 8 it would be partnering with the University of Queensland's Sustainable Minerals Institute (SMI), as well as mining companies Newcrest Mining, Vale, OZ Minerals, BHP and PT Merdeka Copper Gold to develop the Cave Mining 2040 initiative.

The consortium will collaborate on projects to develop new cave mining methods that will be both viable for the industry and sustainable for the environment. The first wave, called Horizon 1, will focus on eight research areas, including total deposit knowledge, cave engineering, cave establishment, mine design for emerging technologies, high stresses and major seismicity. Horizon 1 will also look into macro-block design and sequencing optimisation, sublevel caving and open automation platforms.

While research organisations are eager to work with mining companies to meet their needs, Epiroc's Eklind says they are often surprised by how far hard-rock cutting technology has come.

Most customers still think of mechanical cutting technology as applying only to infrastructure and soft rock, Eklind says. "We can show it is applicable in many cases," he explains.

Future developments in hard-rock cutting technology will likely tackle ways of optimising mechanical forecasting, as well as using radio waves and microwaves to weaken the rock. Automation also remains a leading demand from mining companies, Eklind notes.

Dehkhoda believes the next 15 years will see a hybridisation of mechanical cutting tools, combining traditional cutting tools with novel methods. Lasers, too, will play a role.

"While alternative methods such as lasers are energy-intensive as primary cutting and breaking tools, as an ancillary to a continuous mechanical cutting tool, they can be very effective and economically viable," she says.

In the future, she adds, we will likely see a combination of microwave, electrical impulse, laser or other novel techniques working with traditional and mechanical cutting machines to cut rock.

Dehkhoda also believes drill and blast will eventually be phased out as mines go deeper.

"Drill and blast will no longer be favoured due to increased costs, and the negative impact of blast explosions on the stability of underground structures," she predicts. Because of this, mining companies will be demanding more effective and more efficient hard-rock cutting machines to access deeper deposits.

*Epiroc's Mobile Miner 22H at the face in Anglo American's Twickenham platinum mine in South Africa*