Making waves in Minnesota

Sandvik's DR412i rotary drill rig is setting a new standard for blasthole drilling in Minnesota's iron-ore range

By Staff reporter

While there are many instances in mining where the old adage 'bigger is better' rings true of equipment, there are a growing number of applications where efficiency trumps size.

Sandvik recently helped a longstanding taconite operation in Minnesota, USA, to transition from a fleet of four electric-powered rotary blasthole drill rigs, to two new diesel-powered Sandvik DR412i units. These smaller rigs, equipped to drill narrower holes, have helped the mine to realize large capital savings, reduce its operating costs and increase production.

Paul Morgan, Sales Support Manager at Sandvik's Rotary Drilling Division, explained: "Most mines in that area drill 16-inch diameter blastholes. However, a few years ago, this mine moved to drilling 12 ¼-in holes using their existing equipment. It worked well, and they were able to reduce their drilling costs by 40%.

"The existing units were more than 25-years-old though. They were the only electrically driven pieces of equipment on site and the mine was spending a lot of money to maintain the infrastructure in the pit."

In 2018, the mine began exploring options to replace the rigs. As there was no longer a requirement to drill 16-in hole sizes, it was possible to consider smaller units. The engineers had seen benefit of moving to 12 ¼-in holes and were open to testing even narrower holes of 10 5/8-in. However, the company wanted a machine that could handle both hole sizes.

The mine selected Sandvik as the supplier thanks to the robustness of its equipment and speedy delivery time. The first DR412i was delivered in early 2020 and, following commissioning and setup of digitally-enabled features such as 3-D navigation, Auto Drill and OptiMine, the rig was soon carrying 56% of the mine's production.

"The mine was able to shut down two of its electric machines and replace them with one diesel unit," said Morgan. "Since then, we've supplied a second rig and the mine has shut down all of its electric units from production."

OPTIMISING EVERY BLAST

In switching from a 12 ¼-in hole to a 10 5/8-in hole, and also from electric to diesel, the mine saw multiple benefits.

The DR412i is designed to drill 8.0-12 ¼-in (203-311 mm) rotary holes, with a single pass capability of 59 ft (18m) and a maximum depth of 105 ft (32 m) with a standard mast. These specifications meant it was a good fit for the application which had a depth requirement of 50-55 ft in extremely hard ground – around 450+ MPA.

"We sent the first unit to site equipped to drill 10 5/8-in holes, but with all the components to convert it to 12 ¼-in if necessary," said Morgan. "We never installed those components. The 10 5/8-in setup worked phenomenally well."

In moving from 12 ¼-in to 10-5/8-in holes, the mine has reduced its blasting costs by a further 20-25%. Although the burden and spacing have been adjusted, the parameters are still close to those used for 16-in diameter holes and this has reduced the use of explosives.

"Because the hole size was reduced, it was also possible to reduce the stem height at the top of the hole," said Morgan. "The blast bell curve has come up in the hole, so there is better fragmentation than with the 16-in holes. This reduces energy requirements downstream in crushing and grinding too."

LOWERING OPERATING COSTS

The smaller hole size has also sped up drilling times and reduced tooling costs; a 16-in drill bit costs from US$8,000-10,000 per bit, whereas a 10 5/8- in bit costs $2,500-3,000. As 10 5/8-in is a globally recognized bit size used in commodities and mines across the globe, the market is also wider and there is a greater choice of cutting structures and configurations.

"With each 16-in bit, the mine was drilling 1,000-1,200 ft tops," said Morgan. "Now, with the 10 5/8 bit, they get the same footage out of each individual bit. They're buying ►

"Since the DR412i units have come to site, they continue to set records"

Moving to intelligent rigs equipped was a big change for the workforce

The Sandvik i-Series line of Intelligent Drills

three times as many bits because they're drilling faster and it's still cheaper."

Since the DR412i units have come to site, they continue to set records. The first machine drilled more feet in a month than the mine has seen since it began production, and the rigs routinely drill double the feet-per-shift achieved with the electric rigs.

Although the diesel units warrant an increase in fuel costs, the flexibility they deliver as well as faster tramming speeds make it worthwhile. Additionally, they remove the need for operators to handle high-voltage electrical cables – a major safety improvement.

Overall, reducing the size of the rig almost halved the mine's capital outlay. That, combined with the reduction in operating costs and increased production rates mean that the Sandvik rigs are on track to deliver a quick return on investment.

AN INTELLIGENT FUTURE

Moving from older mechanical drill rigs to intelligent rigs equipped with autonomous drilling capabilities was a big change for the workforce, but Sandvik worked with the mine to support the transition.

Today, Sandvik has three full-time technicians based in the area, plus a fully equipped service facility. This presence has allowed it to work with the operator to develop a new adaptive version of its Auto Drill program which is now being rolled out to other customers globally.

Morgan explained: "This feature gives the machine more control over the drilling parameters based on the ground conditions. For example, if it's hitting soft ground and needs more feed speed, it can adjust that, if it's hitting broken ground and seeing spikes of pressure, it can dial back the speed. The algorithm can react much faster than an operator and it's generating huge efficiencies."

The team recently developed a similar Auto Drill algorithm for a Brazilian mine based on the success in Minnesota. The rig outperformed a competitor model by 30-40%.

Ultimately, with Sandvik's help, the mine in Minnesota is working towards remote operation of its drill rigs from a control room on site.

"This site is turning heads," said Morgan, proudly. "We have a lot to offer mines in Minnesota and we've proven that we can transfer that knowledge and experience to clients in other markets too."

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