

Highwall mining: a safe and cost-effective means of mining.



METHOD IN HIGHWALL MINING

Simon Walker and Dave Bundy, SHM, UK and US, discuss what has been achieved in a recent highwall mining operation.

Headquartered in Summersville, West Virginia, Contour Mining Corp. operates two Superior (SHM) highwall miners, producing low-cost coal on a contract mining basis for resource owners in the Appalachian coalfield. Having begun highwall coal recovery using augers in 1985, today the company operates two SHM miners, with work sites in West Virginia.

The company's first experience with an SHM highwall miner came with a mining contract that it carried out for Peabody. Peabody took the machine over, and the company acquired another, SHM No.27, in April the following year.

The company used the machine for approximately 18 months on a couple of minesites, then in August 2004 it began a new contract for Amvest Corp. at its Powellton Coal Co. mine near Jodie, West Virginia. It bought its second SHM highwall miner, No. 46, in April 2006. Since then it has been working at United Coals' Century property, located near Buckhannon in the north of the state.

Contour's Powellton site used the No.27 highwall miner, which produced a staggering 1.87 million t of coal during 34 months of operation. That comes to an average of over 55,000 tpm, a figure that does, however, mask some real achievements. The company's maximum monthly production came to 71,560 t in March 2007, beating a previous monthly record by just over 600 t. When you consider that the seam was averaging 52 in. (1.47 m) in height, it shows just how productive the machines can be, even when using a low-seam cutterhead.

Furthermore, the average figure does not take into account the time needed for a major overhaul to the cutterhead, which Contour Mining carried out, in-house, in July last year. Involving a total rebuild, this was the first such work that the cutterhead had needed since new, having mined at least 2 million t in the meantime.

The cutting edge

SHM's highwall miners have the capability to carry both low-seam and standard-height cutterheads. This gives increased flexibility, especially where operators are working in small reserve areas, or where two or more seams of differing recoverable thicknesses can be accessed. Low-seam cutterhead modules can mine seams from 28 to 72 in. (710 - 1625 mm) in thickness, medium modules are designed for work in seams 36 - 90 in. (915 - 2290 mm) thick, and high seam cutterheads are used for seams from 50 in. (1270 mm) to 16 ft (4.8 m) thick.

Depending on the individual application, cutterhead drums can be

provided with diameters ranging from 22 in. (560 mm) to 44 in. (1120 mm). While the company uses Joy 12CM and 14CM series cutterheads for thick and medium seam applications respectively, its low-seam unit was designed in-house. Just as in a conventional continuous miner, in-seam coal is cut by sumping the cutterhead forward, then raising or dropping it in an arc, allowing the cut coal to fall to the gathering-arm loader below.

SHM's cutterhead differs from the larger designs in that it has cutter chains along each side to augment the output from the rotating drum. The head cuts an entry 9 ft 6 in. (2890 mm) wide with, in the case of Contour Mining's Powellton contract, a 4 ft 6 in. (1370 mm) pillar being left between adjacent entries. The science behind designing an appropriate relationship between entry and pillar widths has become increasingly sophisticated as experience has been gained throughout the highwall mining industry, with the US National Institute of Occupational Safety and Health (NIOSH) having been instrumental in developing the design criteria that are in use today.

Of course, any design has to take into account the actual ground conditions and rock strengths that exist at any given site, and what made the company's record output even more impressive was the fact that roof conditions in the seams being mined were far from ideal. The Powellton and No.2 gas seams at the Amvest site are separated by between 3 m and 15 m (10 - 50 ft) of soapstone interburden, with the roof of the Powellton seam in particular variable in its integrity at best.

Better than predicted

The major overhaul on the cutterhead and the miner that took place last year allowed Contour Mining to get a better idea of the real costs of highwall mining than had been possible before. SHM expected Contour Mining to spend approximately US\$ 100,000 a year on maintenance and repairs to the cutterhead, but the real figure has been significantly less than that.

To give an idea of the costs that the company incurred - last year, keeping the cutterhead working cost 29 cents/t, including the rebuild. To put that into context, the cutterhead's cost during

the first quarter of this year, during which time it only underwent regular maintenance such as the replacement of picks and cutter chains, was 15 cents/t.

When the company started at the Powellton site in August 2004, it was getting approximately 25,000 t of coal from a set of chains. It worked with the chain manufacturer to make improvements to the design, so now it is producing over 125,000 t from a set, something that the company has never achieved before. That obviously makes a big difference to the cost of keeping the system running, as this was not a soft coal seam. Its Hardgrove Grinding Index of approximately 50 confirms that there is a fair proportion of harder rock within the seam itself, making for more abrasive cutting conditions.

With the No.27 machine now working on a different site with a mid-seam cutterhead, the company has had the opportunity to bring the low-seam unit back into its workshop for another check-up.

Pushbeam maintenance

The cutterhead is by no means the only maintenance item on a highwall miner, with the pushbeams coming a close second in terms of per tonne costs. The pushbeams fulfill two functions: not only do they transmit the sumping force generated by hydraulic rams on the miner vehicle itself to the cutterhead, but they also provide the means of transporting cut coal back along the entry from the cutterhead to the mine bench.

In order to keep the cut coal as clean as possible during its journey to the surface, SHM has focused on an enclosed transport system rather than a belt conveyor on which the coal can be contaminated by falling roof rock. Each 20 ft (6.1 m) pushbeam contains two 17 in. (430 mm) diameter augers that interconnect sequentially as each new beam is added during mining, with the augers and their bearings subject to constant abrasion from the damp cut coal as it is fed along.

In addition, the pushbeams themselves have a hard life, with the bottom being pushed and pulled along the entry floor and the top and sides requiring resistance to impact from falling rock as well as to corrosion from any acidic water present. In order to give as long a working life as possible,

SHM has its pushbeams constructed from high-tensile corrosion-resistant Cor-Ten steel for the top and sides, and Hardox abrasion-resistant steel for the bottom.

Safety first, second and third

Contour Mining is proud of its safety record. In 2005, its Powellton crews worked over 33,000 hours without a lost time accident (LTA), resulting in the company achieving a top three place in the annual Sentinels of Safety awards for small mine operations. Here, four-man teams worked 12 hour shifts on a four days on/four days off roster, with a total of 16 operators on the payroll.

For last year, however, the company is optimistic of another award, since the team clocked up over 38,000 hours without an LTA while producing 647,000 t of coal.

Looking ahead, the company is now evaluating potential worksites for No.46 SHM machine. While No.27 is mining in a 2.4 m (8 ft) seam at another Amvest site before its low-seam cutterhead is

reinstalled, the company expects No.46 will be moving to a new contract within weeks.

Moving an SHM miner holds no fears for the company, which has already done this several times in the past. It has given one example of the timeframe involved in such a move, explaining that this particular machine had finished mining on a Saturday morning, was split into its transport modules and completely rebuilt at a new site by the following Friday, and was back at work within two more days.

It typically takes four to five hours to break down the miner and get it on to trucks ready to move. The company does all the disconnecting of hydraulic lines and power cables, and unbolts the parts, and then the haulage company brings in a 150 t capacity crane and loads them onto trucks. At the other end, it's just the reverse procedure.

Looking at the current US coal market, the situation is beginning to improve, especially in the coking coal and industrial steam coal sectors that have provided much of Contour

Mining's work to date. The company is also helped by its clients often having long-term supply contracts that are not affected by swings in spot market prices.

Since acquiring its first SHM highwall miner, Contour Mining has been extremely proactive in innovating new design concepts for its machines. Having been the driving force behind the development of the 90° rear discharge system that SHM now fits as standard to all of its miners, it was also instrumental in helping SHM to develop its gamma-detector system for accurate in-seam steering of the cutterhead.

The most recent overhaul to the No.27 has brought the machine up to date in terms of its operating systems, transducers and other critical parts, demonstrating that it is possible to retrofit new technology to the existing design. With this included in the cost of less than 50 cents/t in keeping the machine fully operational during last year, this is proof of the system's capabilities of producing low-cost coal. ■