

# Continuous operations

Miners have always looked for more continuous mining systems where possible. IM looks at recent developments in open pits, with ever-larger in-pit crushing, higher capacity conveying and bigger machines

**D**evelopments in continuous surface mining are all helping satisfy the voracious demand for coal around the world. For instance, ThyssenKrupp Fördertechnik is delivering a new continuous coal crushing and haulage system for Huaneng Yimin Coal and Electricity's phase 2 expansion of the Yimin open pit coal mine in China. The mine, close to the town of Yimin in Inner Mongolia, supplies coal to the local power station of Huaneng Power International, one of China's biggest independent power utilities.

Against tough competition, ThyssenKrupp convinced the customer of the technical and economic advantages of its equipment. The total order is worth around €17.5 million and includes the engineering, supply and putting into service of a fully mobile in-pit crushing plant, a crawler-mounted beltwagon, a hopper and cable reel car, a shiftable bench conveyor, a relocatable conveyor bridge (semi-mobile beltwagon), and a transport crawler.

Operating under extremely hard conditions in temperatures as low as minus-40°C, the new equipment will handle 3,000 t/h of coal per hour at China's northernmost open pit mine. A rope shovel will load the fully mobile in-pit crusher with coal directly at the face by without the use of any heavy trucks.

Downstream from the crusher the coal will be transported continuously on belt conveyors, which can be extended vertically and horizontally using the beltwagon to make the overall system highly flexible. Whenever the bench conveyor needs to be shifted, the transport crawler will be used to reposition the semi-mobile beltwagon and the conveyor drive station.

This new continuous open pit mining system will be the first of its kind in China. The fully mobile in-pit crusher is a new development from ThyssenKrupp, which, the company says, "will be the future for all open pit mining operations with large outputs worldwide. For hard and very hard material to be excavated, ThyssenKrupp can supply mobile in-pit crusher plants and all down-stream conveyors with a nominal capacity of up to 12,000 t/h."

Now known just as TAKRAF, VTC Industrieholding purchased the company in August 2006. According to Rainer Kahrger, Chairman of the board of directors, "TAKRAF is poised for growth and increased market share. VTC and TAKRAF share the same vision of supporting TAKRAF's customer base as well as its long term strategies for engineering

and constructing outstanding mining and material handling equipment. This new streamlined ownership structure will enable TAKRAF to focus on its core business and grow and expand without restraints and provide faster response to customer requirements."

A bucketwheel excavator (BWE) SRs 4000 with loading unit in the Troyanovo 1 opencast mine in Bulgaria is a new installation just going into production. This large-scale BWE for overburden removal was supplied, erected and put into operation for the mining company Mini Maritsa Iztok (MMI) in the centre of the largest Bulgarian lignite field, the Maritsa basin. Similar machines built by MAN TAKRAF Fördertechnik (MTF) have been operating in lignite opencast mines in Greece and Siberia under adverse conditions for years.

The MMI equipment system (excavator plus loading unit) has a service weight of 5,730 t, a total length of 158 m, a height of 50 m and was designed for a theoretical capacity (loose) of 11,000 m<sup>3</sup>/h. The equipment was supplied by TAKRAF around 1990 and



Bucyrus dragline

was stored by the Bulgarian mining company on the erection site for about 10 years.

Under a contract concluded between MMI and MTF for 'Technical Assistance' in 1998, MTF and ABB supervisors, designers and quality assurance specialists since 2000, have continuously supported the erection process. In 2003 electrotechnical components (planning/designing and supply of a modern control system, replacement of converter systems, etc.) were refurbished.

The original unit was supplied in 1990 with 3 x 630 kW bucketwheel gearbox, so it was decided that there was need to develop a new gearbox, resulting in a two-motor drive (1,000 kW drive power each). The inner parts of the gearbox such as bevel gear stage, differential stage, antifriction bearings and sensors can be used in a one-motor drive with 1,000 kW drive power, as they are identical in construction. Thus, the requirement was satisfied for the complex gearbox unification between SRs 4000 and SRs 2000 (two-excavator concept) for all opencast mines in the Maritsa basin.

In 2005, after the test run on the test rig, the 70 t gearbox was transported from the Lauchhammer works to the erection site near Kovachevo. On the occasion of Miner's Day in Bulgaria on August 18, 2006, the new BWE system was officially inaugurated and handed over by the Bulgarian Minister of Economy and Energy.

MMI now has the most modern and most efficient excavator in operation in the Balkan region. By the end of September, the equipment was relocated to its jobsite in the Troyanovo 1 mine and commissioning tests at load were finished.

Techint Technologies has been busy this year in Brazil, among other places. The Techint Business Unit Material Handling in June received the Provisional Acceptance Certificate for a large boom stacker at CVRD's Carajas mine. This turnkey project was part of CVRD's plan to increase the production at the biggest iron ore mine in the world, currently set at 80 Mt/y. The new stacker is capable of a nominal operating rate of 11,000 t/h of ore and at a design capacity of 13,200 t/h.

The boom length of this machine is 46 m, supporting a 2,200 mm wide conveyor; able to form a 44 m wide and 20 m height stockpile of iron ore. The conveyor system of almost 1 km length, necessary to feed the stacker, was an integral part of the project performed by Techint.

Also in Brazil, Techint Technologies, through Techint Italmobiliari do Brasil Ltda, has achieved the Final Acceptance Certificate (FAC) related to the refurbishment of the bauxite reclaimer (35 m boom), supplied by Techint itself some years ago, at Alunorte's alumina plant. Techint, responsible for the design, supply and erection on a turnkey basis of the complete refurbishment works, increased the capacity of the reclaimer, originally designed for 500 t/h, up to 1,000 t/h design capacity and a peak of 1,250 t/h. The works were mainly replacement of the bucketwheel, replacement of the boom conveyor and slew drives, and various modifications, including a new feed system to the stockyard conveyor.

Bucyrus International very recently won a contract from Anglo Coal Australia for a Bucyrus 8750AC walking dragline. This came after an extensive analysis by Anglo Coal of the 8750AC's capabilities and the advanced technologies that will be incorporated on this machine. This newest dragline will have a complete AC-IGBT electrical drive system for all motions. Bucyrus, with its partner Siemens Energy & Automation, pioneered the use of AC drive systems on mining equipment nearly 30 years ago. Due to the

reliability and maintenance-reducing advantages of the AC systems, AC drives are fast becoming the norm for heavy excavating equipment in surface mining.

Ultimately the combined drive systems for the hoist, drag, swing, and walking motions of this 8750AC will have over 27,975 kW applied. When in full operating mode it will be able to lower its 95.6m<sup>3</sup> bucket to a depth of over 54.8 m and drag it until it is filled with nearly 168,000kg of overburden material. That full bucket will then be hoisted to a height of over 51.8 m while turning and finally dumping the material over 91.4 m away. This machine's operating weight is some 5,433 t.

Tim Sullivan, President & CEO of Bucyrus, confirmed that machine demand is expected to remain strong. "The sale of this dragline highlights the ongoing global demand for our products and services. We continue to expedite the expansion of our manufacturing facilities to meet this growing demand." Bucyrus is a world leader in the manufacture of walking draglines, and electric rope shovels and rotary blasthole drills.

## Conveying the message

Conveyor drives are a specialization of ABB, with an interesting recent order supplied to Collahuasi copper mine, which is located 4,200-4,700 m above sea level in the Andes and surrounded by northern Chile's brutally barren Tarapacá Desert. The extreme temperatures and the low in oxygen air test the electrical equipment of the mining machinery every day.

The mine bore these conditions in mind when placing the latest order for the electrical equipment of a crusher and a belt conveyor system. It decided on an extremely rugged solution with the reliable Industrial IT Extended Automation System 800xA and ACS 6000 water-cooled medium-voltage frequency converters from ABB. A belt conveyor system to transport the mined material consisting of two rising and one downhill belt, an intermediate bunker and three feeder belts completes this order,

*Takraf SRs 4000 – Transport of 2 x 1,000 kW bucket wheel gearbox for the Bulgarian installation.*



which is now successfully commissioned and in operation. The automation system controls and supervises the transport of copper ore from a new mining area to the existing processing plant.

The heart of the new control system is ABB's Industrial IT Extended Automation System 800xA. For availability reasons the installation is designed redundant, and thus includes redundant aspect and connectivity servers as well as redundant AC 800M controllers (including redundant power supplies) and S800 I/O, which are connected using Profibus-DP protocol. The system handles approximately 1650 I/O signals and about 4500 alarms and events.

A redundant switched network as control network and a single switched client/server network uses more than 13 km of cable to enable information transfer. In this installation fibre optic technology is the first choice. This means the need for repeaters to keep signal levels is drastically reduced and also fibre optic cable is resistant to EMC influences (such as lightning).

ABB's System 800xA Operations user interface enables operators to supervise and maintain the process. Several detailed process displays provide a graphical overview, indicating basic information about equipment status and conditions in configurable colours. Operators may take actions through faceplates, which deliver compressed information about drives, sensors and other devices.

Redundant controllers of this type execute the application programmes to control the crusher and conveyor belts. Because of the high power requirement and the altitude of the mine, medium voltage frequency converters of the type ACS 6000 with new low-power modules are the first choice. They are interfaced and controlled by controllers of type AC 80.

ACS 6000 MD is designed for use under extreme conditions. A total of five 2 MW motors with ACS 6000 medium voltage frequency converters are used in the two rising belts with lengths of 234 m and 2,800 m, achieving altitude differences of 52 and 223 m, respectively.

Three ACS 6000s power another belt conveying material down a vertical distance of about 340 m. The regenerative drives of this belt, which spans a distance of about 5,400 m, return braking energy back to the power network resulting in substantial energy saving.

The four-quadrant ABB drive ACS 6000 MultiDrive W is provided with direct water-cooling, which makes the converter extremely compact and silent, while providing the robust design



**ABB's System 800xA Operations user interface enables operators to supervise and maintain the process.**

needed for these harsh conditions. Direct water-cooling provides for a much smaller design, saving up to 50% of space. It delivers an extremely low audible noise level and avoids excessive ambient temperature variations. Additionally it reduces the need for high-power filtered air-cooling in the installation rooms. Along with the high efficiency, direct water-cooling offers effective and easy heat transfer without air filtering problems.

Although Spain's Capotex does not manufacture belt conveyors, it does optimize them. It foresees future changes in belt conveyor technology. The company developed the self-supporting cover for belt conveyors 20 years ago and over the last three years it has concentrated on redesigning the belt conveyor concept and associated equipment. In May 2006 it opened a new cowl factory in Valladolid, which has become the most advanced in the world, Capotex claims. The company says the current main objective of belt conveyor manufacturers and users is to completely eliminate workplace accidents, pollution and material losses, all with reduced maintenance. The Capotex product design focus is on clean, safe and low-cost. Its experience has demonstrated the efficiency of self-supporting covers to simultaneously reduce dust emission and accidents. Now Capotex is proposing to adapt such covers to all equipment associated with belt conveyors, to further reduce emissions and accidents, even to completely eliminate them.

## Bulk material handling drives

Bonfiglioli's A120 bevel helical industrial gearbox is a large industrial drive especially suited to demanding bulk materials handling

tasks. The 60,000 Nm parallel shaft drive, coupled with a 185 kW electric motor, is the largest model of a type of a drive particularly suited to conveying, elevating and mixing applications. The A120 and the even higher capacity HDO bevel helical and HDP parallel shaft drives have globally proven capacity to cope with the shock and impact of intermittent loads.

Such drives are proving themselves in Australia. "At Boral they have been specified to give long and reliable service handling intermittent loads from trucks unloading concrete aggregate at rates up to 3,000 t/h," says Bonfiglioli's National Sales Manager, Steve Samson. The 87-m conveyor, with 1,200 mm belt, rises from horizontal at the truck unloading point to an angle of 20° at the discharge point, moving at 3 m/s.

"Because they are designed from the ground up for great reliability in dirty and aggressive environments, the same design features that make them right for Boral also make them right for processing applications in mining." These medium and medium-heavy A120 bevel helical gear units are available with double or triple reductions and torque capabilities up to 61,000 Nm.

A120 gearboxes offer excellent flexibility as a result of their numerous machined sides and mounting options. They feature SG cast iron cases with machined mounting faces on the top, bottom and sides to facilitate mounting in several positions. They are symmetrical, eliminating the need for left and right-handed gearboxes. They also accommodate most common output shaft requirements, including solid, hollow and shrink disc fittings. **IM**