As demand for more reliable and less carbon-intensive bulk transport methods in mining applications grows, interest in overland conveyors and next-generation drive technologies is increasing. German manufacturers are leading the way when it comes to the development and installation of these systems, and many are employing digital tools and technologies to provide a new level of accuracy and efficiency through startup and operation.

**Siemens Drives Productivity at Quellaveco**

In October, Siemens’ Mining Division announced it would supply gearless drive technology to power thyssenkrupp’s new high-capacity overland conveyor at Anglo American’s Quellaveco copper mine in Peru. Christian Dirscherl, vice president for mining, Excavation and Transport at Siemens, said that the motors for the project have already been manufactured.

Once up and running, the new conveyor will transport 127,500 tonnes of primary crushed ore per day from the pit to the stockpile adjacent to Quellaveco’s copper concentrator. Large sections of the overland conveyor must traverse from one valley to another through a 3.2-km-long tunnel. After exiting the tunnel, the conveyor will pass over hilly terrain before feeding the stockpile.

Compared with the combination of high-speed motor and gearboxes otherwise used in belt conveyor systems, the gearless drive solution offers a range of benefits. The size of the motor is no longer limited by the size of gearbox, thus eliminating the necessity to install multimotor drives. The required belt driving power can be provided with one drive per drive pulley. This means that the number of switchgear enclosure could also be scaled down, saving space and weight within the e-house. The elimination of a whole series of mechanical and electrical components increases the reliability and efficiency of the overall system by between 3%-4%.

Another important factor is that the maintenance requirements of the drive system have been significantly reduced. This is important as gear maintenance work alone can account for up to 5% per year of the original investment volume for the gears.

thyssenkrupp’s overland conveyor is 4,700-m long and 1,830-mm wide. It will feature Siemens’ dual 5.5-MW gearless drives operating at a design tonnage of nearly 11,000 tons per hour. Siemens will also provide the e-house with MV and LV power distribution and the cooling system for motors and e-house. The automation of the conveyor system as well as for the complete mine will be realized with the process control system Siemens PCS-7.

“This order again shows how gearless conveyor systems meet today’s demand for ever more efficient mining solutions and increased safety requirements,” Torsten Gerlach, former CEO of thyssenkrupp’s Mining Technologies business unit, said upon announcing the contract. “It is the seventh overland conveyor project of this magnitude utilizing gearless drives that have been awarded to us since 2010. Together with our partner Siemens, we have managed to become one of the world leaders in bringing this technology to the market.”

**From Drives to Digital**

Siemens is also working to supply gearless mill drive systems for several copper projects in South America, Russia and Asia, and recently received an order to supply the drive system and automation for new mine hoists at a greenfield potash project in Belarus.

“The project includes the electrification, drive system and automation with our latest developed SIL-3 winder controller for four mine hoists,” Dirscherl said. “One of them will be used to lift people and cargoes in the cage shaft, another one will be used as a backup. The other two will be installed in the skip shaft to extract the potash.

“We have also focused a lot on our digital solutions over the past 12 months. For example, on our Simine Material and Quality management (MAQ) solution. With Simine MAQ, we are implementing fully transparency for material handling solutions, such as material tracking, simulation and autonomous operation of stockyards including stacker reclaimers. “Currently, Siemens is working on three large projects, two are for autonomous operation for the stockyards of steel plants in China and one is for OCP Group in Morocco.”

The OCP Group operates several mining sites and processing plants in Morocco. Each of these sites has a large stockyard to ensure even material flow. OCP has decided to equip some of these stockyards with Siemens’ MAQ solution as part of its digitalization program and, going forward, all reclaimers will be operated autonomously by MAQ.
This will lead to increased efficiency and provide the group with access to operating data, such as the status of machinery and overall stock levels.

**BEUMER Takes to the Sky for Construction Logistics**

Equipped with cameras, unmanned aerial vehicles (UAVs) are fast becoming a mainstay in the planning execution and documentation of complex mine construction projects.

For conveyor specialist BEUMER Group, drones are becoming increasingly important in the construction of overland conveyors, some of which can cover many kilometres in difficult terrains.

“We have been working with the drone technology for about three years now. In this industry, drones have become standard equipment, whether it is for measuring construction sites or for operating and maintaining facilities,” said Eugen Doberstein, project engineer for overland conveyors at BEUMER.

“Of the main reasons are the higher standards in occupational safety. The use of UAVs is becoming more and more important for many companies in very different industries. We are mainly using them in the area of plant engineering.”

Lukas Paul, manager for plant design and bulk material handling systems specializes in pipe conveyor design and installation. He explained that UAVs are proving particularly useful in the assessment and quotation phase of projects.

“If customers authorize us to supply and install a belt conveyor, we have to submit a detailed quotation beforehand,” he said. “Here, it is important to assess the project correctly. We usually do not have a lot of time for this. The use of aerial photographs that are analysed by specialized software provides an effective way to accomplish this. This has made drones an important tool for us. They are equipped with high-performance cameras that provide image data that we then use to create a reliable planning basis with our software.”

Paul gave the example of a belt conveyor project in Indonesia. BEUMER was contracted to supply a conveyor that would transport material from a quarry to a cement plant. The planned route led through the rain forest and was very demanding from a topographical point of view, but by using drones, the team was able to work out the optimal route and planning logistics.

“Using the photographs allowed us to recognize, for example, whether the terrain is sloping or whether there are buildings, waterways or a similar obstacle. This allowed us to adapt the routing of the system to environment in an optimum way. If these obstacles are identified at a later stage, the construction of the conveyor becomes much more complex. Depending on the project size, we later even control the complete construction process by means of the drones — whether in areas that are difficult to access or on building sites that are easier to access,” he added.

In the past, tasks such as these would be completed manually by survey teams, but the work is time consuming, expensive and risky for personnel involved.

Doberstein explained: “In the best-case scenario, the users know the field of application because they have previously transported bulk material along the route by truck, for example. Then they are able to provide the required data and we can start working immediately. Later, Google Earth was an alternative. The software superimposes satellite and aerial images of different resolutions with geodata and shows this on a digital elevation model of the earth. However, this data is not as accurate and up to date as the recordings of a drone, which can detect whether a new building has been erected or traffic routes have shifted within a mine.”

**Safer Mine Sites, Lower Costs**

The main benefits of using drones in conveyor construction are the considerable time and cost savings they provide, and not just for the customer.

“If a customer is not yet sure whether they will proceed with the project, we quickly provide them with precise and low-cost data at the time of the project pre-planning phase by means of drone recordings and our further calculations,” Paul said. “On this basis, the customer can make their decision: is the project worth it or not? But we also benefit from significantly less effort and thus manpower, amongst other things, and this is reflected in the costs. Drones are presenting an excellent solution to get a first overview.”

UAV technology has improved dramatically over the past five years. Today, drones are smaller and more stable, and the cameras used are more compact and offer higher resolution. Connectivity has also evolved; the ability to communicate with certain satellites and thus access GPS data means more accurate positioning and flight paths too.

Currently, there are two main design types: copters and fixed-wing aircraft.

“With regard to functionality and characteristics, the copters are similar to helicopters,” Paul explained. “With their rotors they can stand still in the air like their big brothers. Fixed-wing aircrafts, on the other hand, are more comparable to aeroplanes. They also have a higher range. As soon as they are in use, they are constantly in motion.

“Copters are, therefore, particularly suitable for narrow take-off and landing areas or when they have to perform at low speed. Users can control them manually. They mainly fly over medium-sized and small sites. In addition, they are used to inspect mine faces and in construction inspections such as lower sides of bridges.

“Due to the fact that we only need to measure one corridor for a belt conveyor, we use a copter for our projects. If the route is over several kilometres, as it was the case with the Chinese cement manufacturer Sichuan Yadong Cement with a total...
length of 13.7 km, we divide it into several segments, as the drone is only able to fly over the route in sections due to its limited flight time.”

Once the images are received, software is used to create a point cloud which allows the generation of 3D models from the two-dimensional views, i.e., digital terrain models. Depending on the scope of the project, this can take between one day and two weeks.

These benefits are all very attractive, but Paul pointed out there are additional legal considerations when determining whether drones are right for use on a project.

“In Germany, we have to consider the legal regulations of the aviation law and the air transport authorization regulations,” he added. “In addition, there is the copyright and data protection law as well as property and personal rights of third parties that does also limit the use of camera-equipped drones. Abroad, however, this is not always clearly defined and can vary from country to country. It all starts with the question are we even allowed to transport the drone in the plane to its destination.”

Voith Ups its Game With Integration and Automation Services

Voith specializes in intelligent hydrodynamic drive systems for belt conveyors. The TurboBelt TPXL coupling is the company’s newest offering for the mining industry. This a hydrodynamic, fill-controlled coupling featuring the latest digital technology including sensors and an intelligent control system. The hydrodynamic profile is optimized to achieve the best possible energy efficiency and reduce the coupling dimension to a minimum for a fit perfectly within the drive train. This translates into optimized startup behavior, a longer lifetime and reduced downtime for the entire belt conveyor.

Fabian Korb, product manager at Voith’s Turbo division explained: “The TurboBelt is suitable for the power the range between 350 kW and 1,250 kW at 1,500 rpm, and can be used in belt conveyor applications with temperatures ranging between -40°C and +50°C.

“Compared to its predecessor, we redesigned the valves and added an intelligent pump to control the filling in the working circuit. This allows better accuracy in torque-controlled startup and reduces the number of parts on our coupling.”

The TurboBelt TPXL is controlled by Voith’s TurboBelt Drive-Control system, which handles the complete startup and control process. This is equipped with a touchscreen display for easy parametrization. The display provides the operator with all necessary information on the performance of the equipment including warning and error messages.

“We use one TurboBelt DriveControl per belt conveyor,” explained Korb. “With this device, self-programming is reduced to a minimum to save time and costs. If you have one of our couplings installed in your mine site and would like to expand or upgrade a different drive, it is possible to install the TurboBelt DriveControl on any kind of fill-controlled fluid coupling.

“The TurboBelt DriveControl comes pre-parametrized according conveyor data from the project phase. Only minor changes on site are necessary which reduces the installation time. The controller is equipped with a router including a VPN connection to a secure server. This router can be connected either via the mine network or via GSM if you include a SIM-card. This is not a must but a possible option in case if you need assistance from our worldwide service network.”

In the event that mines need assistance, Voith’s engineers can access the controller via a secure server and help to solve the issue.

“Our wiring in the controller is so secure that we can’t access your main control system via this communication path,” Korb added.

If mines are within the project phase, Voith also now offers a detailed startup simulation of the conveyor.

“For this, we have special tools developed to calculate all necessary parameters,” Korb said. “Our trained sales and support experts can advise you based on this calculation and simulation what is the best solution for you. The simulation and values will be integrated as a pre-parameter set into the TurboBelt DriveControl to achieve a fast commissioning.
“Dimension-wise, we have 3D data of our coupling available so that we can show our customers exactly how it will fit mechanically into their system. During the project phase and while commissioning, we have mechanical experts who can assist with hardware implementation and IT specialists who are able to help integrate our controller into their main control system. After commissioning we can assist via our VPN device to tune and optimize the system to achieve your perfect startup.”

Korb said that conveyor startups can also be automated. For example, the client can specify the startup time and requirements such as minimum wear and stress on the belt, and the TurboBelt Control Drive will take care of the rest.

“The benefit for the client is that they don’t have to self-programme the system,” he explained. “They can benefit from our experience and our learnings from other installations. We continuously develop our software with feedback and share this with our other installations.

“In the past, we only offered startup components for belt conveyors. However, some mines had difficulties integrating them into their control systems and it took time to get the components working properly. We took this onboard and developed our own controller. The first responses from clients who are using our automation system are promising; that we are faster in commissioning and our coupling works from the first moment as described.”

Last year, Voith oversaw the successful installation of its couplings and control system at an Australian bauxite operation.

“We got the offer from the client end of March 2019 and shipped the couplings beginning of June 2019,” Korb explained. “According to the client’s requirements, we had to change each exiting coupling and start the belt conveyor again within 24 hours. The first window of change was possible in December 2019. Prior to this hardware change, a software pre-check happened to analyze all signals between the client and the TurboBelt DriveControl worked. The second coupling will be changed in February 2020 in the same amount of time. So far, the system is performing very well.”

The mine bought its first couplings from Voith in 1989 and the new units replaced two of the older ones that were reaching their end of life.

“Our TurboBelt TPXL was considered because of perfect fit and easy integration within the given timeslot of 24 h. Also, they can still use the existing motor and gearbox,” Korb said. “With any other solution on the market, the amount of work would have meant increased time and costs for the client.”

**ABB’s 2020 Technology Updates**

ABB is a complete end-to-end, full scope, design-build-lifetime partner for the mining industry. Drawing on 60 years of sector experience, the company has a broad offering for optimizing mining performance from mine to port. ABB’s digital technology spans total integrated solutions across electrification, automation, digital, drives and motors, and infrastructure and its digital applications draw on advanced libraries and software solutions to reduce process complexity.

Some notable updates from ABB to look out for at Expomin in Santiago in April and MINExpo later in the year in Las Vegas include:

• **ABB Ability MineOptimize** which encompasses optimized engineering, optimized electrification and automation solutions, digital applications and collaborative services to reduce cost, minimize risk and improve efficiency.

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**ABB Ability™ MineOptimize**

Unified and enterprise-wide way to digital transformation

[abb.com/mining](http://abb.com/mining)
• ABB Ability Performance Optimization Services for material handling. This is a Web-based, on-the-fly analysis and reporting application for material handling, based on stand-alone data science methods including machine learning and artificial intelligence. The application contains a widespread portfolio of analysis services (KPI toolbox) for specific topics as energy consumption, downtime, low load, alarm and events among others to identify performance optimization potential. Individual analysis services, which address specific needs can be developed based on a common customer journey process. The modular and flexible add-on-and user management approach enable a customized analysis of assets, processes and plants, while dashboards can be individualized according to the specific needs of the different users from the operational field up to management level.

• And, ABB Ability Stockyard Management System. In recent years, digital solutions for optimizing the material flow in the bulk material market have become more and more important. Since the ABB Ability Stockyard Management System (SYMS) was introduced with a pilot in the domestic German market by 2009, several successful implementations followed in Europe and Asia.

“During the last decade, ABB underwent ongoing efforts to tailor-make SYMS to be more closely aligned to the customer needs, for a variety of bulk material and facility types,” explained Peter Muelbach, ABB’s vice-president of process industries, Germany. “Thanks to the continuous improvement of the system in an intensive exchange with the operators, ABB is today able to offer a comprehensive solution for seamless material flow tracking, real-time material analyzing, material storage and blending planning and fully autonomous machine operation.

“The next version will include further features such as re-
claiming performance optimization based on AI and the seam-
less integration into the ABB Ability MineOptimize portfolio which covers the complete haulage chain from pit to port.”

Driving the World’s Most Powerful Conveyor

Recent projects at which ABB technology has been deployed and which illustrate the company’s expertise include the Chuquicama underground mine project in Chile where the world’s most powerful gearless conveyor system is now in operation.

ABB, in exclusive cooperation with Tenova TAKRAF, has finished the commissioning and test operation of the three principle 11,000-t/h conveyors, coming from the new underground mine, over an altitude difference of about 1,300 m at a distance of 12 km. Their main gearless conveyor drives (GCD) are equipped with large ABB — AC synchronous torque motors with a rated power of 5 MW each, resulting in a motor shaft torque of about 900 kNm.

“The transportation system, based on this continuous con-
veying technology, eliminates the need for 120 large haul trucks. This results in the saving of about 130 million litres of gasoline consumption per year, reducing the carbon emission by 240,000 t per year,” Muelbach said.

In addition to the Chuquicama project, ABB has re-
ceived an order from a European mine operator to replace the shaft-mounted geared drives of an existing conveyor system with medium-powered GCDs with synchronous PM motors. The conveyor system connects the open-cast mine with the associat-
ed power plant.

“The gearless drive, as an upgrade solution, will be de-
designed in a way that it can replace the geared drive unit without considerable modification of the existing drive pulley and main structure. It will be 100% exchangeable — back and forward compatible — with the existing geared drives,” said Muelbach. “The main customer motivation to go for this gearless upgrade along with a conveyor relocation were fre-
quent failing motor bearings due to vibration issues as well as the need to meet the EU noise limits. The silent GCD tech-
ology makes additional measures to reduce conveyor noise emission unnecessary.”

Cooperation With Komatsu

ABB’s continued successful cooperation with Komatsu is another example. The long-term partnership with Komatsu for ABB AC Drives for shovels has culminated in the successful commis-
sioning of the largest rope shovel 4800XPC which can handle the three-pass loading of the Komatsu 980E haul truck.

Muelbach added: “This a milestone of productivity in combi-
nation with a highly reliable AC Drive system based on ABB’s global product platform ACS880 Multidrive. Over twelve years ABB AC Drives have been proven in more than 100 shovels of type P&H 4100 around the world in different climates and chal-
 lenging mining conditions.

“The AC Drives are known as one of the best in class high-power, low-voltage drive systems with excellent dynamic response time behavior of the direct torque control (DTC) and the multidrive design with a motor to motor energy usage. This leads to energy savings and a lower CO2 footprint, and is re-
ducing the machine fleet energy consumption. A universal drive module concept, with the same type of inverter for the supply and motor side, gives a maximum of flexibility for an efficient service and compatibility with all types of electric shovels avail-
able from Komatsu.”

One of the next mid-size electric rope shovels, the 2300XPC, will use the same AC Drive platform from ABB and will com-
plete the portfolio of AC Drives on five different types of electric shovels. ABB AC Drives are also the core part of retrofit and upgrade projects for different shovels and draglines in various mining areas.