

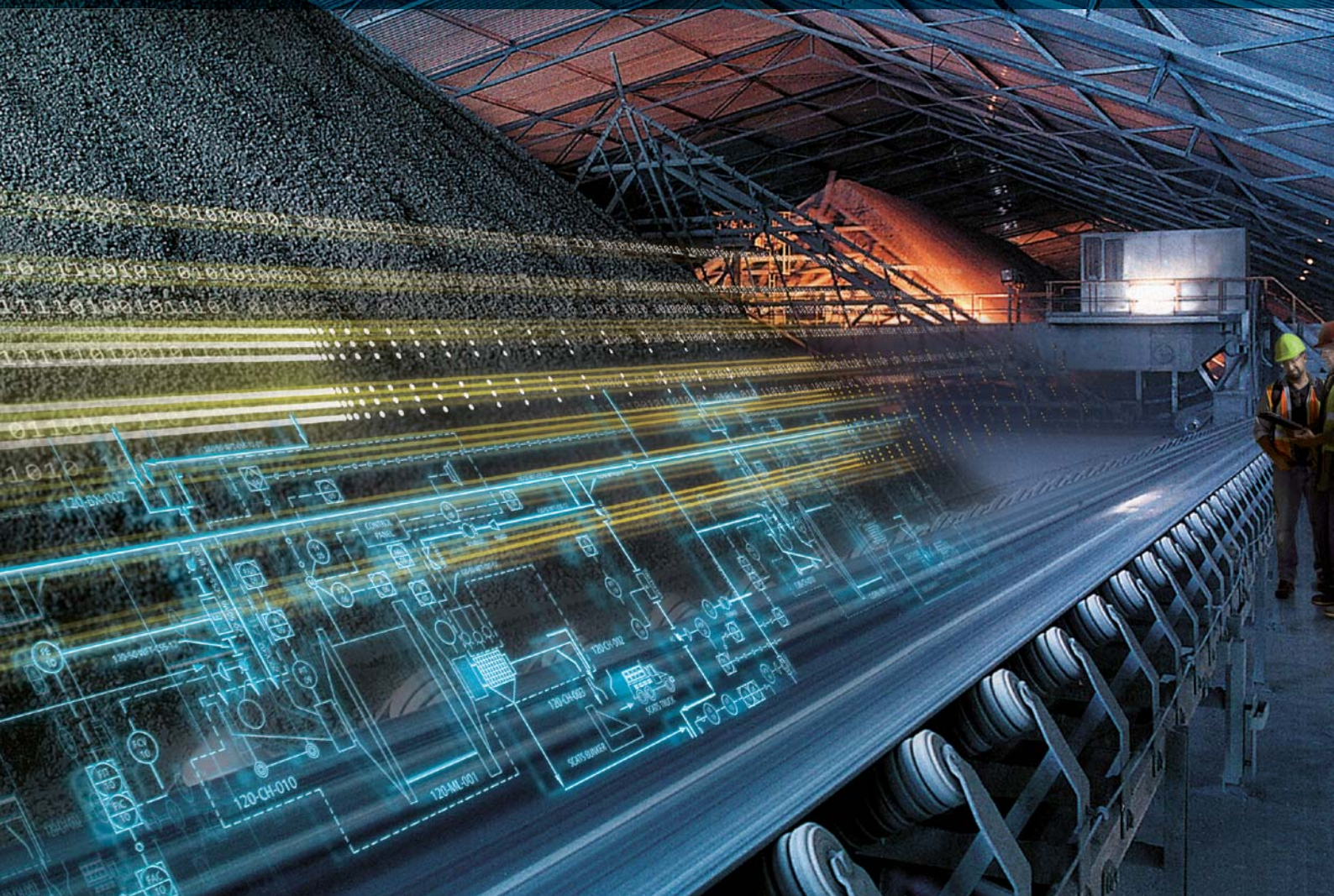


SIEMENS

Issue 2015

# MineralsFocus

The Magazine for the Mining and Cement Industries



Cover Story:  
**The future is today**

Mining:  
Tailor-made  
modernization

Cement:  
Cemat – 40 years  
in service



Edzard Lübben

*“With some 17,500  
software engineers  
worldwide, Siemens  
counts among the  
world’s biggest  
software companies.”*



## Dear Reader,

Products from Siemens are built to last. A prime example is the mine winder, which Siemens started supplying over 110 years ago. Or our Gearless Mill Drives – some of which have been in operation for over 40 years. Throughout their service life, these machines have been modernized and kept up to date. The same approach has been taken for Cemat, the process control system for the cement industry, which is now celebrating 40 years in service: All along, Cemat and Minerals Automation Standard – the Simatic PCS 7-based process control system for the specific requirements of the mining industry – have been continuously updated. But at Siemens, it's never change for the sake of change: customers are our top priority, and the guiding principle is that innovations answer their challenges and respond to the industry's key concerns. In today's world, software is playing a bigger and bigger role.

Many are surprised, in fact, to learn that Siemens employs some 17,500 software engineers worldwide. These engineers work on a complete portfolio of industry software to support customers along the entire value chain – from product design, production planning and engineering to actual production and service. Their work results in automation and digitalization solutions for all industrial verticals Siemens serves.

In this issue of MineralsFocus, we show how an increased use of automation and digitalization technologies can help minerals producers to better adjust to changes in the market. This technology is part of a bigger development happening under the umbrella of Industrie 4.0 – also known internationally as the Internet of Things – which is an initiative in the German government's high-tech strategy. The vision of Industrie 4.0: machines largely organize themselves, supply chains automatically coordinate themselves, and products supply all their production data to the machines on which they'll be manufactured.

But getting to this vision won't happen overnight. Incremental steps are necessary. Today some essential steps can be taken in the minerals industry to increase the degree of digitalization. So whether we're talking about tools for automation, engineering or planning, minerals operators get assistance to counter some of the current problems in the market, such as declining grades and price volatility. And they get closer to the vision of Industry 4.0.

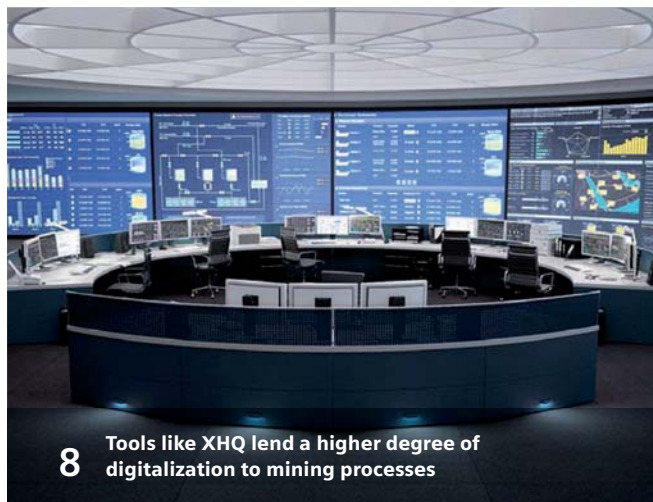
Aside from addressing this fascinating topic, in this issue we also review minerals projects all over the world. Sitrans LR560 is helping operators at the Holcim cement factory in Intervaz, Switzerland, to accurately measure solids (page 44). Holcim in Brazil has increased its production levels with the addition of a MultipleDrive vertical mill (page 46). In the mining sector, the Frozen Charge Protection function and Frozen Charge Shaker solve the problem of falling charge, and thereby keep downtime low (page 16). Naturally, these are just a few examples of the stories you'll find in this issue.

We look forward to your feedback – and the opportunity to work together with you to solve the challenges you are facing.

Sincerely,

**Edzard Lübben**  
Head of Minerals

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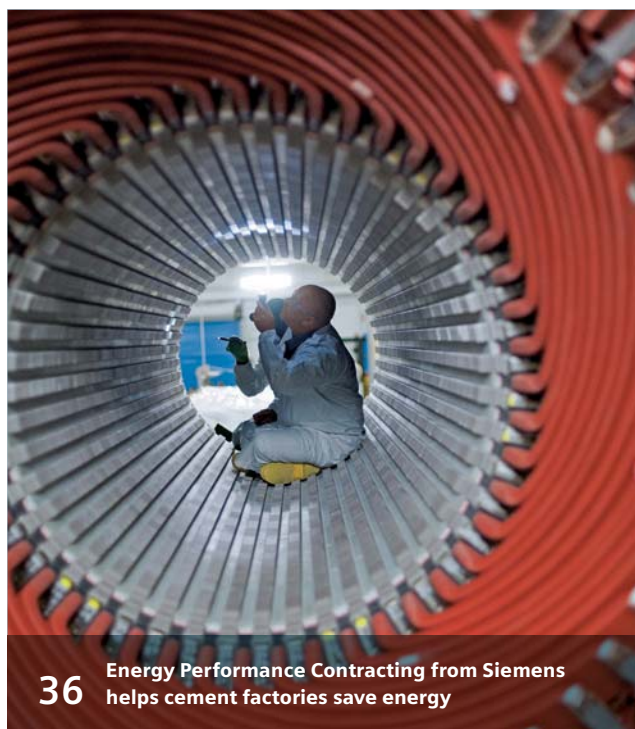
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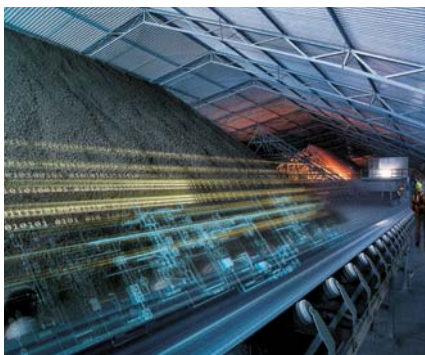
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## Learning from other sectors

As manufacturers look to the future, they are examining how advanced information and communication technologies can boost value creation. In Germany, this development is called Industrie 4.0. While some sectors are far along on the path toward Industrie 4.0, the mining industry is still at the beginning. It is time that mining companies embrace digitalization innovations that have proven their value in other sectors.

### Cover Story

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Digitalization of processes will help the mining industry get closer to the vision of Industrie 4.0. Three technologies that have proven their value in other industries have made their way into mining operations: automation, the Comos software platform and XHQ, short for eXtended Head Quarters.

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## Anglo American



Meeting with Anglo American CEO Mark Cutifani at Siemens Tower in Beijing, China, in January 2015 (from left to right): Mondli Guma (Anglo American), William Fu (Anglo American), Robert Lind (Anglo American), Martin Klarer (Siemens), James Harmann (Anglo American), Edzard Lübben (Siemens), Klaus Schmid (Siemens), Mark Cutifani (Anglo American), Ben Williams (Anglo American), Hans-Jürgen Pelloth (Siemens), Paul Cahill (Anglo American), Bin Lin (Siemens), Fu Qiang (Siemens)

# A revolution for open-pit mining

Siemens is cooperating with Continental and ThyssenKrupp on the development and marketing of a steel cable conveyor system for open-pit mines. The system will allow conveyors to be built with inclinations of up to 50°.

The cooperation partners Siemens, ContiTech Conveyor Belt Group and ThyssenKrupp Industrial Solutions are laying a milestone for the reduction of heavy-duty truck traffic in open-pit mines. Together the three partners are implementing the Chevron MegaPipe steel cable conveyor system, a high-strength steel cable conveyor belt with an outer diameter of up to 900 mm. The new technology will make it possible to economi-

cally transport ore and overburden over slopes with inclinations of 30° to 50°. As a result, new market segments can be tapped.

## Siemens delivers drive technology

The construction design of the Chevron MegaPipe requires drives in the megawatt power range. Siemens solves the challenge with a direct

drive, which has no gears between the drum and motor. Initial feasibility studies have proven safe transmission of up to 8 MW. "Our direct drive for belt conveyors is the ideal solution for the Chevron MegaPipe: Because of the chevron profile, the traction of the drum to the belt is possible with only one drive drum. Furthermore, with steep conveyance, a considerable higher lifting power is necessary. Our self-developed direct drive tech-

# Anglo American focuses on automation and digitization

Anglo American underlines the importance of Siemens products, solutions and expertise for its mining operations.

In January 2015, top officials from Anglo American and Siemens met at Siemens China's headquarters in Beijing to share insights and identify potential areas for further collaboration in automation and digitization. The Anglo American delegation was led by Chief Executive Officer Mark Cutifani.

Anglo American is focusing on the automation and digitization of its mine planning and processes as part of its broader innovation drive to build up efficiencies, enhance returns and generate greater value. With the help of leading technologies and by rolling out

a new operating model, the company aims to further improve its operational performance to deliver sustainable change. This work will position Anglo American at the leading edge of technology development and innovation across the mining value chain.

Speaking at the meeting, Mark Cutifani emphasized the value of Anglo American's long-standing partnership with Siemens, particularly in heavy equipment supply, digital design and energy efficiency. The collaboration ensured that Anglo American remained aware of new technological

opportunities. He also acknowledged that Siemens's experience offered his company learning opportunities from other industry segments, such as the oil & gas, chemicals and automotive sectors. The automotive sector, for example, is a forerunner in using automation and digitization for just-in-time delivery. This experience could provide valuable insight for Anglo American's new operating model. ■

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## Siemens, Continental and ThyssenKrupp



Together the cooperation partners want to set a milestone for the reduction of heavy-duty truck traffic in open-pit mines.

nology has already proven its value in many installations," says Norbert Becker, Vice President of Siemens Mining, Excavation & Transport.

The three partners look back on a history of successful collaboration. In 1985, for example, a conveyor system from ThyssenKrupp was equipped with direct drives from Siemens and with the ST7500 conveyor belt from ContiTech.

"For the development and marketing of a new technology, we need experienced and dependable partners. We have found just that in ThyssenKrupp and Siemens," says Hans-Jürgen Duensing, Head of the ContiTech Conveyor Belt Group. ■

#### Links:

[www.siemens.com/mining](http://www.siemens.com/mining)

[www.contitech.de/press](http://www.contitech.de/press)



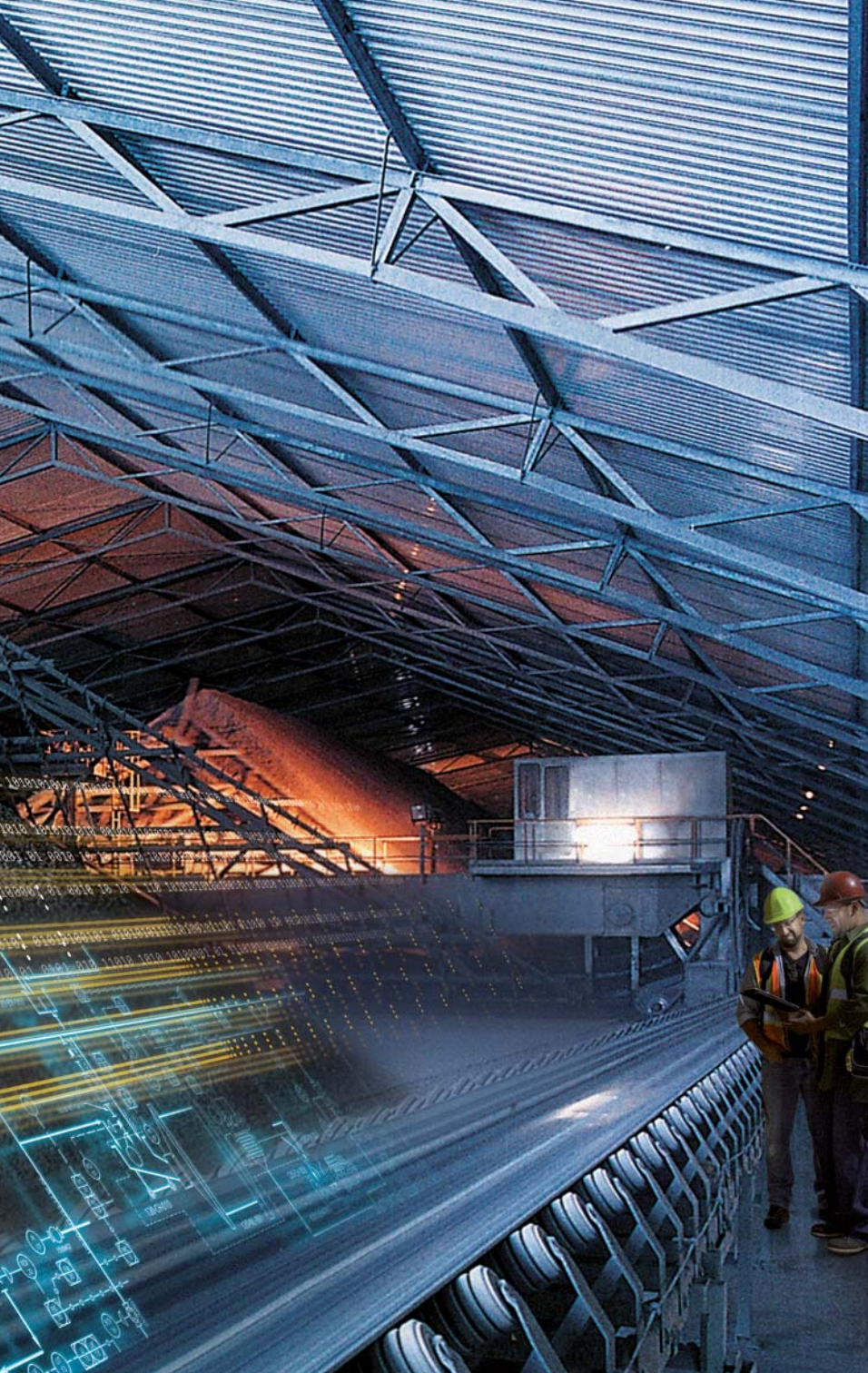


Automation/digitalization

# The future is today

The Internet of Things – which is an essential part of the German initiative Industrie 4.0 – is synonymous with the digitalization of industrial processes. While some industries are far along in the digitalization of manufacturing processes, others like the minerals sector still have some ground to cover. Technologies are available today to help mining companies increase digitalization and at the same time tackle the woes plaguing the industry.





"Tracking the trends 2015" also includes quotes from experts, which together paint a future of increased digitalization. Their overall message is that by adopting innovative technologies and making increased use of information technology (IT), mining companies can put themselves in an even better position for the next upswing. Simply put, digitalization can be seen as a valuable tool to help mine managers to do their jobs even better.

## More digitalization

The idea of expanding the use of technology and IT to gain a competitive advantage is nothing new. Basically, this is the cornerstone of a movement to embed more and more objects with electronics, sensors and software, and allow the objects to communicate with one another via the Internet. Fittingly, the term Internet of Things has been coined for the trend. For many branches of industry, the Internet of Things is seen as a spearhead for a revolution in manufacturing. In Germany, the Internet of Things is an essential part of an initiative called Industrie 4.0 – an initiative of the German automation industry sponsored by the German government. Its objective is to define the way forward for manufacturing companies in the Internet age.

Thomas Walther, who is in charge of Minerals Automation at Siemens, says that Industrie 4.0 means introducing more intelligence to a process industry over the entire lifecycle: "From planning to commissioning, including operations and maintenance, more steps that were previously completed manually will be done without human intervention." Some industries have been quick to adopt a higher degree of digitalization in their processes and are already closer to this vision of Industrie 4.0. A forerunner in this regard is the automobile industry. The mining industry, however, is still at the beginning. As suggested in the Deloitte trend study, it is time that mining companies embrace innovations that have proven their value in other sectors. When thinking about where Siemens can offer well-proven elements from other industries for the specific challenges of the mining industry, three solutions stand out in particular: end-to-end process automation ►

**D**eclining grades. Price volatility. Project suspensions. These are just some of the lesser-than-pleasing trends that companies in the minerals industry have to contend with. Unfortunately, there is no indication that these challenges will let up anytime soon. Part of the answer, it seems, can be found in how mining firms organize themselves and their business processes.

This is the general tenor in "Tracking the trends 2015," a study from the

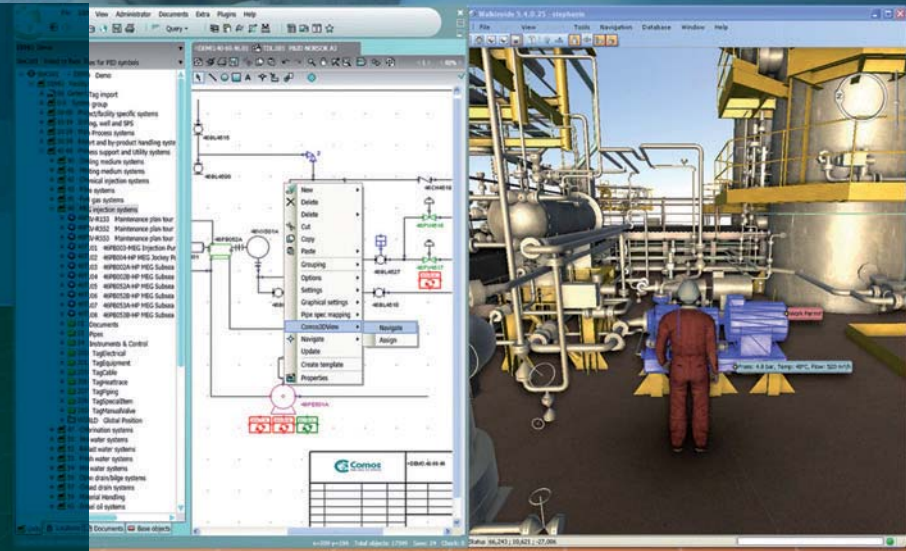
Deloitte consultancy firm on the mining industry. The study lists the top ten issues mining players can expect to confront this year and strategies to buck the trends. The first three deal with improving operational excellence, among others by collecting and using data intelligently; embracing innovation, including technologies and applications now used in other industries and applying them to solve problems in minerals production; and reducing costs, particularly for energy.





## Simatic PCS 7 – the Siemens automation workhorse

Simatic PCS 7, upon which Minerals Automation Standard and Cemat are based, has been installed in around 20,000 projects in all process industry sectors. The country with the most Simatic PCS 7 installations is China, follow by Germany and the United States. A recent implementation of the Minerals Automation Standard was in Peru for mining company Hudbay Peru. Siemens installed the complete electric and automation solution, including 5 client operator stations, 6,000 process objects, 5,800 I/O and 35 modular I/O stations.



- and instrumentation; the engineering and application software Comos for the entire plant lifecycle phase which in turn serves as a basis for completely digitalized production; and a software platform like XHQ (eXtended Head Quarters) that collects data from a number of sources to give decision makers and management a real-time condensed overview of all information so they can make the best decisions possible.

### Automation: the basis

For quite some time, Siemens has been laying the groundwork for digitalization. The introduction of Totally

Integrated Automation (TIA) in 1996 enabled the coordination of components in production processes, allowing companies to closely integrate their software and hardware. Siemens has since continuously enhanced the TIA offering. In 2007, the company introduced a comprehensive family of product lifecycle management (PLM) software products, to which it is continually adding more modules. The aim of PLM software is to optimize product development. And to achieve this goal, design, prototype development and simulation take place in the virtual world so that development times can be significantly reduced.

In the mining industry, the groundwork for the journey toward digitalization starts with rock-solid automation – automation that boasts the highest availability, reliability and efficiency possible. Automation can be seen as the brain, a closely knit network of sensors and instruments as the eyes and ears, and integrated drive systems as the body. Minerals Automation Standard is Siemens' process control system for the specific requirements of the mining industry. Minerals Automation Standard is closely related to Cemat (see page 40), the market leader for process control systems in the cement industry. More than 40 years of matured



## Industrie 4.0

As manufacturers look to the future, they are examining how advanced information and communication technologies can boost value creation. In Germany, this development is called Industrie 4.0. Similar initiatives have been launched in other European countries, China, the United States and elsewhere. Industrie 4.0 aims to achieve production-related advantages by creating a networked, flexible and dynamically self-organizing manufacturing process for highly customizable products. Over the next 15 to 20 years, it is expected to be accompanied by a paradigm shift that could justifiably be called the fourth industrial revolution. The result will appear to be revolutionary from today's point of view, but ultimately it will involve a large number of development steps in a process of evolution.

The first industrial revolution was triggered by the invention of the steam engine and the mechanization of manual work in the 18th century. The second revolution was made possible by the introduction of electricity and involved the use of mass production techniques in the early 20th century, and the third was ushered in during the past few decades by electronic systems and computer technologies for automating manufacturing and finishing processes. Now the rules are changing again in many sectors, due to the digitalization of the entire value chain and continuous and pervasive access to a comprehensive range of information in the form of virtual models, data and knowledge.

functionality for automation of cement plants and for typical mining automation application functions are combined in the solution. With the migration concept integrated into the automation, the investment of a client is protected and at the same time the operator can profit from the latest innovations in the software standard.

Minerals Automation Standard ensures that operators receive the best support for performing their duties. Innovative and proven functions for operation and integrated maintenance functions assist in fast diagnosis of potential faults – even before the appearance of a problem. Downtimes are thereby reduced. The mining-specific library provides the best route to increased operational efficiency. Especially in regard to engineering: pre-defined and proven functional modules and faceplates for many applications and processes make engineering easy, fast and reliable. Minerals Automation Standard utilizes the modern process control system Simatic PCS 7 with its open, flexible and scalable architecture as its system platform. The advantage of a high level of automation is that operators know the status of each piece of mechanical equipment.

Only when a control center has access to all the data at a mine can it begin to leverage that data to improve overall day-to-day operations. Automation alone isn't enough – everything has to be connected with one another. However, mines are generally in remote areas with a harsh environment. Furthermore, great distances between the different process steps are the norm – for example excavation at the top of a mountain and beneficiation in a lower-lying valley. It therefore takes special technology to connect the process automation and individual plant sections as well as mobile equipment like trucks in the different parts of a mine. Standard communications networks fit for harsh environments like products in the Ruggedcom portfolio from Siemens do the job. They link everything at the field level and transport the data into the overall network. Adherence to international standards such as IEC 61850 and IEEE 1613 ensure reliable communications and secure transmission. High levels of electromagnetic inter- ►

## Anglo American counts on Minerals Automation Standard

*“For future developments, Anglo American Platinum will be focusing on digitalization and automation of its production processes. The Siemens Minerals Automation Standard will be key to meeting these requirements and it offers an ideal basis for economical and future-proof solutions.”*

Gary Humphries, Head of Process Control at  
Anglo American Platinum Limited



XHQ Enterprise Operations Intelligence displays all critical information so that operators can make the most informed decisions.

► ference, extreme temperatures and long distances are not a problem for Ruggedcom, which employs industrial tethered and/or wireless communication for high levels of mobility and flexibility. Through the use of standard communication protocols like Profinet, real-time communication is possible and commands can be relayed to equipment that is moving and kilometers away. The Siemens network communication portfolio offers customers a comprehensive range of products for fully integrated network infrastructures from a single source that can be quickly deployed.

### Savings with smart engineering and beyond

The Deloitte study calls on mining operators to reduce costs, particularly with energy. Siemens has a wealth of experience in this area, for example with highly efficient drive trains in which all components are ideally designed to fit with one other. For existing systems, Siemens performs in collaboration with customers energy audits to produce a transparent picture of all consumers in a mine and to identify potential to reduce energy consumption. The audits also include a return-on-investment calculation. End-to-end automation, of course, makes carrying out an audit a great deal easier. There is, though, another solution from Siemens that can help save money, and not just in the operations phase:

Comos, the plant engineering software platform. The software solution contains applications for all plant lifecycle phases, from engineering and operations to modernization as well as dismantling.

At the heart of a plant operating with Comos is a common database. Because all data is always available and up to date, it depicts the actual as-built status of a plant at all times. This is especially helpful in planning modernizations, since there is no need to catalogue the current status of a plant with the arduous task of updating old plans. Formerly separate fields such as process technology, mechanical and electrical engineering and control technology are all combined into the standardized data structure of Comos. Furthermore, Comos simplifies data exchange between partners and suppliers, thereby helping to avoid misunderstandings.

A special aspect of Comos is the range of software solutions for the entire plant lifecycle. Three applications come to the fore in the engineering phase: Comos Platform provides a basis for effective overall data management. The creation of process data and all aspects of process engineering are covered in Comos Process. Comos Automation supports electrical engineering for a plant through to full automation covering all processes relevant to electrical, instrumentation and control engineering. Comos Automation also has a Simatic PCS 7 interface for exchange

and software engineering with a distributed control system (DCS). All data created during the engineering phase can be reused in the operational phase.

For the operational phase, Comos Operation assists in implementing an efficient plant support strategy. Available applications include solutions both for maintenance during ongoing operations and overhaul during shut-down. Comos Lifecycle supports comprehensive information management throughout all plant lifecycle phases. The benefit is maximum reliability in decision-making. Plant operators have worldwide access to data and documents, so they can react quickly to changing market demands. "Perhaps one of the greatest advantages of Comos is that changes made in one application are immediately reflected in all other applications," says Walther. Cement plants operating with Comos enjoy significantly lower costs – by approximately 60% – and less effort and time are needed for daily operations. And with completely up-to-date engineering models, it is not unheard of for throughput time to be reduced by more than 50%.

A number of industries are already benefiting from Comos. In pharmaceuticals, the Swiss company Novartis Pharma AG in close cooperation with Siemens launched a program for a standardization of its engineering worldwide. Since 2004, Novartis Pharma has been successfully using the Comos software solution for the purposes of plant engineering, lifecycle data management and plant documentation. In the meantime, the entire engineering at the main production sites – including process technology as well as electrical, measurement and control technology – has been carried out exclusively with Comos. The customer reports significant improvements in terms of efficiency and quality.

### The big picture with XHQ Enterprise Operations Intelligence

Comos offers worldwide access to data and documents, but that is generally not enough to make the most informed decisions. Therefore, Siemens offers XHQ Enterprise Operations Intelligence; XHQ stands for eXtended Head Quar-



ters. Originally created for the oil and gas industry, XHQ has long found use in other sectors to aid in improving operational excellence through the collection and intelligent use of data.

Operations personnel throughout all levels of a manufacturing organization typically struggle to pull together a complete, timely picture of a situation. Like missing pieces of a puzzle, critical information is often scattered throughout a variety of databases, enterprise applications and operational systems in a wide range of formats with a confusing mix of unrelated contexts. Only when this information comes together in a meaningful way can it be used to react to a given situation. Therefore, XHQ extracts, aggregates, relates and presents operational and business data from a variety of information sources – enterprise resource planning (ERP), data warehouse, production databases, document management systems, process historians and manufacturing. XHQ provides users with a wide, unique range of coherent, up-to-the-minute information. This data is then used to monitor performance and make better, more informed, actionable decisions – for greater efficiency and reduced costs. XHQ can be easily customized for each user.

The true advantage of XHQ comes from the fact that decision makers have relevant, personalized and easy-to-understand information at their fingertips. Production plants can be tracked in real time, and the data can be compared, for example, with price indices, KPIs and other company production sites, wherever they may be. This information allows operations performance to be taken to the next level. Answers to questions such as how am I doing against objectives, how are we doing collectively, and what should we do in this situation given current conditions can be answered easily with XHQ.

For the mining industry, XHQ gives operators access to real-time information that can strengthen the ability to maintain performance of equipment used for mining operations. With XHQ, operators can monitor equipment performance within specified operating parameters, based on a metrics strategy. Operators can reduce the probability of operating limit exceedances using alarms, alerts and notifications to en-

sure the most effective troubleshooting. Access to this equipment health monitoring data can be made available to operations managers, equipment operators, sensor vendors and service personnel to provide important transparency for equipment health, and thus can be used to improve and sustain mining operations.

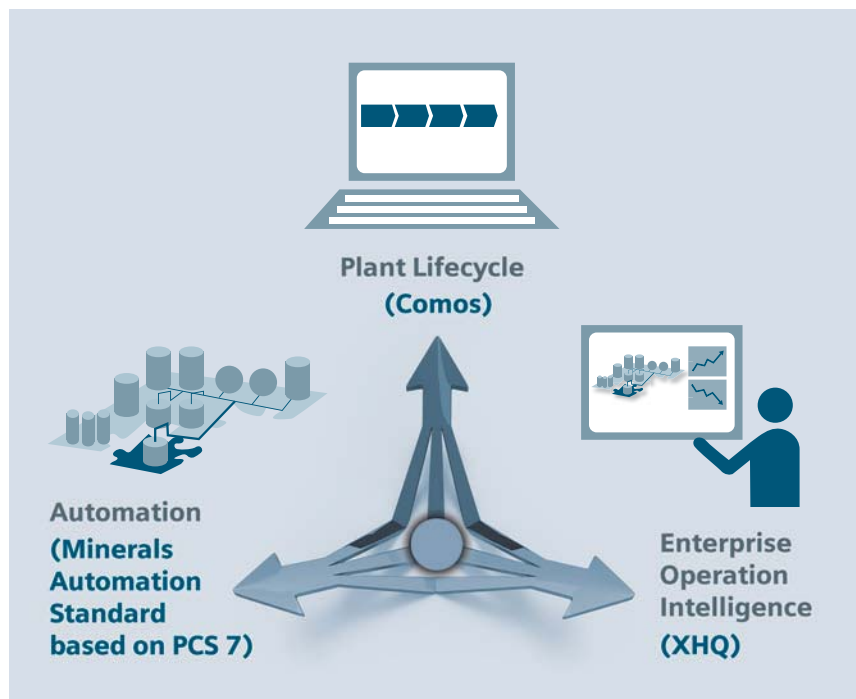
Influenced by a successful implementation of XHQ and a Manufacturing Execution System (MES) over the last seven years in its steel plants, a Brazilian customer selected Siemens business Chemtech to deploy XHQ and MES to control the entire iron ore production chain from the Casa de Pedra mine to the port of Itaguaí. XHQ is totally integrated with MES so that operators can manage the production and logistics of the mine-port supply chain. Custom KPIs and a drill down to individual segments are established according to the needs of each user. XHQ consolidates data generated by MES in a standardized and simplified way, guiding the analysis of managers and supporting the decision-making activities of process coordinators.

### Great potential for minerals

All of the solutions described above are available today – and they have been individually employed at mining sites all

over the world. “Until now, there still isn’t a mining industry reference in which all the solutions we mention here have been installed,” says Walther. However, as more and more companies make investments in digitalization, he is optimistic that it won’t be long before there is one. The willingness to invest in measures to increase productivity looks good.

The BNamericas Mining Survey 2015 reports that 93.5% of mining company respondents are planning to make investments in 2015 to improve productivity. One aspect includes automation and technical improvements, and better equipment maintenance practices. In all cases, Siemens has extensive experience. Those who embrace a higher degree of digitalization will increase their flexibility and be able to more quickly adjust to changes in the market. The problems facing the minerals industry today do not look like they will be gone anytime soon. The possibilities of digitalization, however, can ease the way. Siemens is using its expertise to help the minerals industry become more effective and save money. The only prerequisite is a willingness to embrace innovation. With more digitalization comes access to the most up-to-date information. So whether we’re talking about price deterioration or lower ore grades, operators can find the best solution to ensure profitability. ■



Tailor-made modernization for increased longevity

# Bringing control technology up to date

Many Siemens Gearless Mill Drives (GMDs) have been in operation for decades. Last year, the combined operation of all GMDs from Siemens in the mining industry reached 500 years. While motors easily achieve this lifetime, the situation with electronic controls can be different. Rapid advancements in electronics and computer technologies have allowed significant progress in the control technology of mill drive systems.



The control part of a GMD includes not only the direct control system for the motor, but also low-voltage distribution, transformer protection, automation (PLC), visualization (HMI), and peripheries like the air-gap monitoring system and speed sensor. All these systems can be affected to some degree by the technological aging process.

Siemens has been successfully modernizing selected equipment at installed systems for many years. However, the introduction some years ago

of the Sinamics SL150 drive control system for the cycloconverter to replace the Simadyn technology triggered an extensive engineering development with the specific aim of evaluating the complete electrical component of the older systems, defining adequate substitute solutions and developing alternative modernization concepts. The result of this development is a variety of innovative approaches, based on standard modules, to modernize the existing mill drive to a state-of-the-art system in order to prepare it for many

further years of continuous and reliable operation.

Of course, each GMD is individual, so there is no single modernization blueprint or one-size-fits-all concept. Rather, the most suitable modernization solution has to be worked out in close cooperation with the customer.

It is important to keep in mind that the grinding mill is probably the most critical bottleneck in the mine production process, and each hour of downtime represents a potentially heavy financial loss for the customer. There-



Anton Bartinger, Technical Director of the Cement Division at the Rohrdorfer Gruppe, on a modernization project implemented in January 2015:

"Everything worked so smoothly that the conversion process was completed without me noticing much at all. Everything had been planned down to the last detail by my team and by Siemens in advance. We are delighted to now have a state-of-the-art drive system at work in our mill. This project has meant a hugely reduced risk of failure for the mill, which is so vital to our whole production process, and vastly improved availability over the coming years."



Electrical room at Rohrdorfer Gruppe plant with the original converter cubicles (left) and the new converter cubicles (right) installed in parallel.

fore, it becomes evident that the technological aspects are only one of the important factors to determine the right modernization concept. It is equally important to analyze how many shutdown days – intermittent and in total – are necessary for the modernization work.

How can the cutover be reduced to a minimum by expert planning and execution? Which equipment definitely has to be exchanged and which components can remain without compromising future performance? Could a new e-house possibly be installed around the GMD? Can the modernization be combined with a regular mechanical overhaul of the motor? The answers to these and other questions help Siemens engineers evaluate all associated risks and develop a solution that strikes a perfect balance between investment costs, minimum duration of the cutover and expected performance increase.

### Putting experience to use

In the last few years, Siemens has fundamentally modernized more than ten GMDs with the latest automation and drive technology, giving Siemens the possibility to gain plenty of experience in the field and thereby further develop

and improve its modernization concepts. Experience clearly shows how worthwhile it is to spend sufficient time and resources at the very beginning in order to evaluate all possible alternatives and find the best possible technical solution for each application to fit the customer's requirements. Considering the importance of the cutover work and the potential cost of the related production loss, the implementation of the work during the cutover has proven to be just as important as the right technical concept itself. A highly motivated can-do project team and a trusting and cooperative relationship with the customer are additional indispensable factors for a successful modernization project.

The latest example of an implemented modernization project is the GMD in a cement factory belonging to Rohrdorfer Gruppe. The GMD was originally installed in 1969, and was the very first Siemens GMD in operation. At the beginning of 2014, Siemens was awarded a contract to modernize the complete drive system and to exchange the air-gap sensors. The new drive system, an air-cooled converter, was installed in parallel to

the running system. The final commissioning was implemented during a regular shutdown in January 2015. As a result, the actual switchover from the old to the new converter did not cause a single day's loss of production.

Further recent examples of particularly tailor-made modernization projects: a mine in Chile commissioned Siemens for the supply of new control system in a new small prefabricated e-house; a customer in Indonesia ordered together with the modernization of drive control and automation Siemens' newly developed Training Simulator (see page 18); and for a GMD modernization in Australia Siemens was contracted to exchange, in addition to the drive control, the third-party PLC.

Whether for the replacement of single components all the way to complete systems, Siemens offers tailor-made modernization solutions for aging plants. Customers can benefit also by adding new and enhanced features that were not previously implemented on their system, and they can increase the overall performance or even the capacity of their mill drive. ■

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### Benefits of modernization

- Profit from the latest developments in automation and drive technology
- Continue mill drive operation for years to come at high levels of productivity, reliability and availability
- Increase plant availability through improving troubleshooting and diagnostic possibilities as well as personnel training
- Minimize the impact, cost and risk of the modernization work on operations through optimized and standardized packages in combination with other routine work
- Improve serviceability

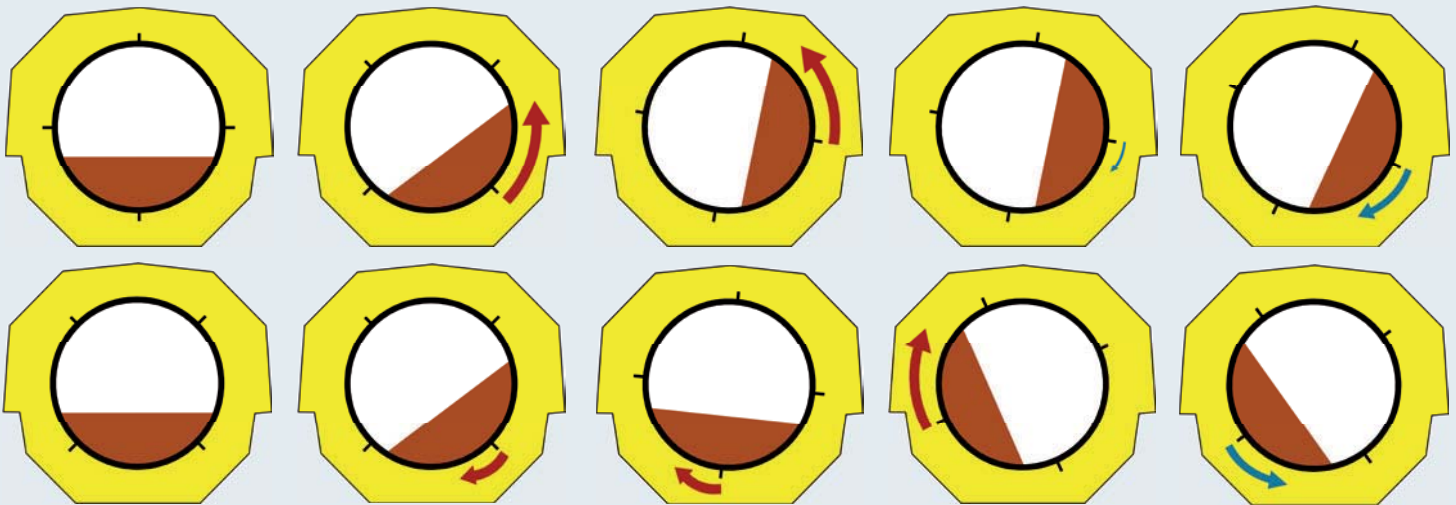
# More uptime for Los Bronces

If undetected, frozen charge can wreak havoc in a mill, all the way to failure of the mill body and bearings. To prevent such an occurrence, Siemens offers the Frozen Charge Protection function. However, as detection alone does not solve the problem, Siemens also provides an automatic solution to loosen the charge: the Frozen Charge Shaker™. Together they keep downtime low, as proven more than once at the Los Bronces copper mine in Chile.

The Frozen Charge Shaker lifts the charge to an angle, safe for the mill.

This safe angle is between the plant-specific cascading angle and below 90°.

The motor then lets the mill fall back, electrically controlled.



In case the charge does not slip, the motor continues turning to the other side and the procedure is repeated.

The motor lifts the mill to the same safe angle...

... and then lets the mill fall back.



**D**owntime is costly. And it is all the more aggravating when it could have been prevented.

When a grinding mill is shutdown for maintenance for hours or even days, the charge remaining in the mill can easily solidify and attach itself to the shell of the mill. This is called frozen charge – also referred to as locked, cemented or baked charge.

How frozen charge can cause additional downtime becomes apparent when a mill not equipped with the Frozen Charge Protection function is restarted. If the charge fails to cascade upon starting the mill and suddenly drops down from the top of the mill after a 180° revolution, it can destroy the body and bearings. Major repairs are then needed, resulting in production loss. This was exactly the case at a 14 MW SAG mill in Ghana. Falling frozen charge put the mill out of commission for 112 hours, and the production loss carried a price tag of \$8.9 million.<sup>1)</sup> However, with the right technology this type of costly incident can be averted.

## Detection – and a solution

Siemens Gearless Mill Drives (GMDs) are equipped with Frozen Charge Protection, which automatically detects frozen charge – and if present, protects the mill by switching it off. Detecting frozen charge is only the first step, however. The charge then has to be loosened. Breaking up material stuck to the mill body through conventional, mechanical means – such as flushing with water jets or using jackhammers – takes several hours or even days.

The modern Siemens GMDs come optionally with a patented solution – the Frozen Charge Shaker™ – to automatically loosen the charge. The shaker lifts the charge to a risk-free angle, and “shakes” the mill by varying its speed and acceleration.

The Frozen Charge Shaker has been deployed in various facilities worldwide, including the Los Bronces copper mine in Chile. In 2011, a 22 MW gearless drive for a 40-foot SAG mill and two 16.4 MW gearless drives for two

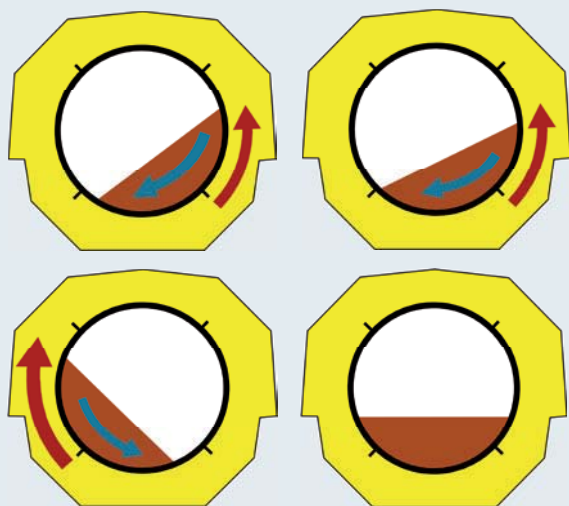
26-foot ball mills were commissioned, all equipped with Siemens GMDs. Not long after commissioning, the Frozen Charge Shaker proved its value: Frozen charge was detected on September 10, 2012, on Ball Mill No. 2. By applying the shaker, the material was loosened and the mill resumed normal operation in less than 15 minutes. No additional flushing and no mechanical removal were necessary, which would have caused downtime of several hours or even days. The same procedure was applied with the same positive results on September 5, 2013, again on Ball Mill No. 2, and on March 20, 2014, on Ball Mill No. 1.

Should frozen charge remain in the mill, despite application of Frozen Charge Shaker, Frozen Charge Protection shuts the mill off so that the procedure can be repeated. The greatest advantage of Frozen Charge Shaker is increased productivity through the reduction of downtime. Above all, the mill itself is protected from major damage. ■

<sup>1)</sup> Published by De Beer, Lombaard, Warner & van Zyl at the SAG Conference in Vancouver, 2011.

Rolled back to a plant-specific angle between 30° and 45°, the motor applies a counter torque of 130° of rated torque. The mill shell stops, and the charge slips, due to the impact of the counter torque.

The mill shell stops, and the charge slips.



Rolled back, the motor again applies a counter torque.

Then the motor stops and switches off.

## How it works

### Frozen Charge Protection

Siemens' Frozen Charge Protection is coupled with the behavior of the mill charge. During normal operation, the charge cascades after the mill reaches a certain angle – between 40° and 70° – at which point the load torque decreases. This decrease in torque is monitored and used by the Frozen Charge Protection function to safely stop the mill before dropping frozen charge can damage it.

### Frozen Charge Shaker

Loosening frozen charge from the mill body is the task of Frozen Charge Shaker. The charge is lifted to an angle safe for the mill, and the mill is moved back and forth with varying speed and acceleration. The angle and movement are designed to break the frozen charge and remove it from the mill body, as proven on many occasions, for example at the Los Bronces copper mine in Chile. With the Frozen Charge Shaker, there is no need to use water jets and jackhammers to remove a frozen charge. Downtime is reduced to a minimum. The Frozen Charge Shaker can be operated on the local control panel by a switch, pad-lockable in the off position.

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Training Simulator

# All the benefits, none of the risks

Senior Sales Manager Stefano P. Scagliola spoke with MineralsFocus about the development and benefits of the Training Simulator for Gearless Mill Drives.

**Stefano, could you please explain what the Training Simulator is, and how and why it came about?**

We got the idea to develop what is now the Training Simulator for Gearless Mill Drives (GMDs) some years ago. Customers approached us with the request for an efficient way to train their personnel on the automation and drive control of their individual system. Their requests were particularly focused on ensuring long-term, sustainable development and retention of knowledge within their teams.

So that's how the R&D project to design and develop the Training Simulator was initiated. In mid-2014, we tested the first prototype.

The main goal of the Training Simulator is to replicate as closely as possible the actual GMD system, including all of the hardware and software. All the main components of the electrical system such as automation, drive control, power system protection and power distribution are installed in the Training Simulator. Even the GMD speed sensor with a small tachometer disk is

integrated. The installed software is also the same version as the one installed on the running GMDs. In order to simulate missing field signals, such as temperature sensors in the motor, we built in some background interventions.

**What exactly does the simulator simulate?**

With this system, customers can conduct a full simulation of all the operations of the GMD. They can start and stop the mill and run it in all kinds of operational modes. It's also possible to



re-program the software and change parameters. This applies to any of the components installed in the simulator. It is a remarkably flexible system.

A large part of the Training Simulator is dedicated to troubleshooting. The device allows trainers to generate specific errors, both in hardware and software, and simulate the most common problems that occur in a mill. This way, trainees have the chance to get familiar with all components and to practice their troubleshooting skills.

A dedicated training plan covers all operation and maintenance activities and leads participants through all the training areas with specific exercises.

**Some would say that they can train their employees on the job. So why should customers choose the Training Simulator in addition to typical classroom training and on-the-job training? What are the advantages?**

Four reasons: highly customized training, efficient and flexible training, no-risk learning, and one that may not be obvious to most – emergency spare parts stock. I'll expand more on each point.

First and foremost, the simulator lets trainees become familiar with the hardware components and software structure. The components and the software are identical to the ones used on a running GMD. Trainees are not learning generic knowledge about some standard components and software, they are learning about *their* system.

Second, personnel can do their hands-on training when and where they need to. We can deliver the simulator to wherever it is required. Trainers can vary the content and depth of the training. And, if need be, training can be repeated unlimited times to help build up skill and confidence levels. In times of increasing staff fluctuations, it's a huge advantage for customers to be able to maintain core knowledge within the team, and get new personnel up to speed quickly without additional investment.

Third, trainees can learn offline in a relaxed environment. Simply put, our simulator provides an enriched training experience with all the benefits and none of the risks attached to conducting exercises on live equipment or waiting for the first real failure to practice.



Drive Engineer Markus Wenzel instructs customers on the Training Simulator at the minerals headquarters in Erlangen.

And, last but not least, the installed components on the simulator – such as the PLC CPU, drive controllers, the Simatic PCS 7 server and the engineering notebook – also function as additional emergency spare parts stock that can be directly installed in the actual system.

**What are the long-term benefits of the simulator?**

The GMD is one of the major potential bottlenecks in the entire mining process. Every hour of downtime causes huge losses in revenue. It's important that all personnel in the mine, from operations to maintenance, become very familiar with this equipment. They should know how to react to problems confidently, effectively and as quickly as possible. This reduces shutdown to a minimum, which in turn increases the already best-in-class availability of our GMDs.

**How can one best integrate the Training Simulator into an overall training plan?**

The Training Simulator is the new complementary module of the overall training plan for our GMD customers, which already included typical classroom and on-site training. We currently offer two different training models with the simulator to our customers.

In the first model, customers can send their personnel to our minerals training facilities either at the minerals headquarters in Erlangen, Germany, or at our Minerals Service Center in Santiago de Chile, where they are trained by Siemens experts on a standard Training Simulator. Alternatively, customers can procure the Training Simulator explicitly for their installed GMDs and train personnel directly on site. We are seeing a huge increase in interest for this second model. The Training Simulator is perfectly suitable both for newly installed GMDs as well as for those with control systems that have been modernized.

An added benefit is that our customers don't have to lose key staff during training, because they can conduct the trainings as needed during normal operations. For some customers, especially those from smaller mines, it is difficult to send four to five people abroad at the same time for classroom training, because it causes a lot of trouble for resource and shift planning. Here too, a Training Simulator on site allows much more flexibility. ■

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Lower CO<sub>2</sub> emissions

# Cleaner coal energy for Serbia

Over the years, Electric Power Industry of Serbia, Serbia's power company, and Siemens have collaborated on a number of projects. The latest undertaking between the two companies will reduce CO<sub>2</sub> and thereby help Electric Power Industry of Serbia achieve targets for pollution prevention as set down in a EU Directive on industrial emissions.

In Serbia, coal means electricity, heating and economic development. In this EU-candidate country, around 70% of electrical energy is produced by a few coal power plants relying on uninterrupted supply from local lignite mines. The most significant set of mines are in the Kolubara basin. Spanning over 600 km<sup>2</sup>, the basin also holds one of the largest lignite reserves in Europe. The mine provides coal for more than half of Serbia's electricity production, playing a vital role in the country's energy independence.

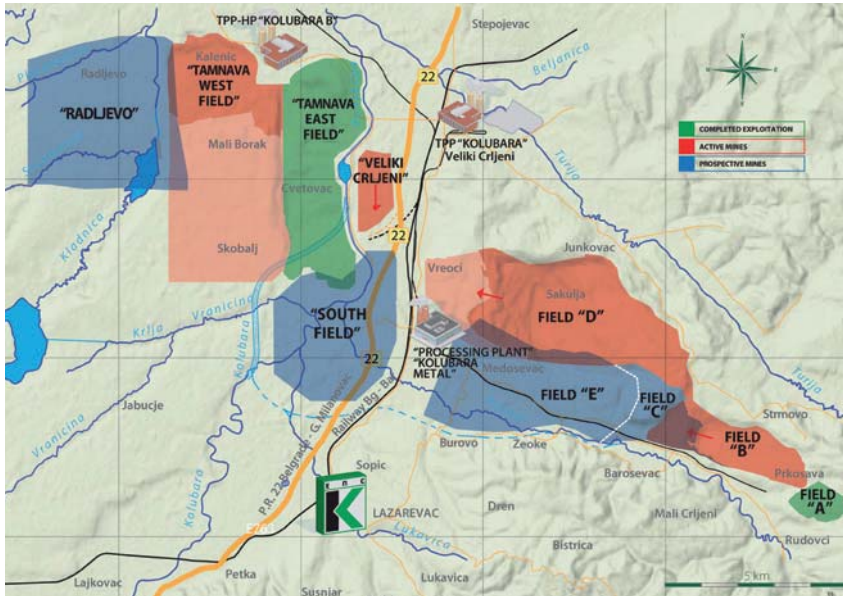
The Kolubara mine currently lacks an online calorific analyzer, causing the quality of coal it delivers to power plants to be highly irregular. To optimize the coal burning process, power plants often have to add heavy fuel oil to the coal, resulting in higher harmful emission levels.

## Project targets environmental improvement

To improve the Kolubara mine's operations and its environmental impact, Electric Power Industry of Serbia, the state-owned electric utility power company that operates the mine, initiated its Environment Improvement ►







## Kolubara mining basin

The Kolubara mining basin is owned by the state. The management and utilization of the mine is entrusted to Electric Power Industry of Serbia, the main vertically integrated energy company in Serbia. In 2013, 30.7 million tons of coal were excavated in Kolubara's four operational open pit mines – Field B, Field D, Veliki Crljeni and Tamnava West Field.







Two Sinamics complete drive systems with Simotics motors with a total power rating of 3 MW propel the 34-meter-high giant. The control system and all safety functions are based on Simatic S7. (Photos pp. 20–23 courtesy of Electric Power Industry of Serbia.)

- Project in 2011. The venture involves introducing a coal quality-management system on open-pit mines in the western part of the Kolubara basin to ensure that coal from different fields is blended properly and is of uniform quality. Another important component of the project is the acquisition of a new excavator-conveyor-spreader system for Field C in the east. For the first phase of this project, Siemens will supply the complete electrical and automation equipment for the 6,600 m<sup>3</sup>/h excavator, which is being provided by ThyssenKrupp. Siemens will also supply electrical components for the spreader system. The system will help the mine increase production of higher calorific coal, which is important in yielding the right quality blend.

With new equipment in place, operators at Kolubara will be able to extract resources more cleanly and efficiently, and power plants can stop using liquid fuel to compensate for low lignite quality. The upgrade will reduce CO<sub>2</sub> emissions by an estimated 200,000 tons and help plant operators meet the stringent emission limits set by EU Directive 2010/75 on industrial emissions.

### Long-term cooperation

Electric Power Industry of Serbia and Siemens enjoy a long-standing collaboration spanning decades, and the contract described above is just one of many modernization projects Siemens

has been contracted to implement for Kolubara. "For years, Kolubara has been successfully cooperating with Siemens. In fact, Siemens electrical equipment is present on the production systems in all four active open-pit mines. The new and modern electrical equipment has a significant impact on our technological process," comments Milorad Grčić, the Director of the Kolubara Mining Basin. As early as November 2014, an electrical and automation package for a newly built bucket wheel excavator – BWE SchRs740L – was commissioned. The SchRs740L excavator, with a capacity of 4,800 m<sup>3</sup>/h, was provided by ThyssenKrupp in cooperation with the local subcontractor Kolubara Metal. Siemens completed the basic and detailed electric project design and delivered the complete electrical equipment, as well as the design and commissioning of the control software. Controller S7-400F, with technological and control functions as well as safety functions covering all running modes of the machine, was utilized for the SchRs740L. The latest control and visualization software, and HMI systems based on Comfort Panels and the SCADA system WinCC, make the machine easy to maintain and use.

### Reconstruction after flooding

The partnership between Kolubara and Siemens was strengthened after the floods and landslides that oc-

curred in May 2014 in Serbia. Roads and bridges were damaged, and hundreds of thousands of people were forced from their homes. The total effect of the disaster was assessed at circa €1.5 billion – a third of which fell to the mining and energy sector, which was hit hardest. Kolubara's largest coalfield, Tamnava West, was flooded, leaving almost all of the mine's production equipment submerged under several meters of water. "We immediately contacted Siemens for assistance in the process of rehabilitating and revitalizing the equipment," recalls Milorad Grčić. The complete reconstruction of the electrical systems of the two flooded bucket wheel excavators G1 and G4 was awarded to Siemens.

These and the many other projects Siemens has completed at the Kolubara mine are a display of the company's strength as a strategic partner in the fields of automation and drive technology for mining. And of course, Siemens is also well positioned to contribute to similar capital projects in the country. In fact, Siemens is confident that many exciting projects are still to come in Serbia. ■

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## Mine winders

# Master of all options

When electricity came to play an increasingly important role in the mining industry toward the end of the 19th century, Siemens was at the forefront. Following on from the first electrical mine railway in 1882, the first electric-powered mine winder was installed in a pit in the Ruhr area in 1904. Looking back on a track record of over 110 years, Siemens has supplied more than 800 electrical mine winders to the mining industry with an installed capacity in excess of 1,000,000 kW.



**T**he first mine winch with a 29 kW electrical motor produced by Siemens was installed in Transvaal in South Africa in 1896. The capacity of that winch was 600 kg at 3 m/s rope speed. The mine winch was delivered with a specially developed centrifugal governor to make the operation of the winch easier and safer. In the same year, a mine winch with a 66 kW electrical motor was delivered to the col-

liery Carl G. Falck in Bokwa, Germany. These smaller hoisting machines were the forerunners in the development of a drive system for mine hoisting. Carl Köttgen was the leading person in the development of mine hoist systems, and he made a great effort to obtain the Ilgner converter license for Siemens & Halske. The first electric mine winder and fed by a Ilgner converter was put

into operation at the colliery Zollern II in 1903. This mine winder had payload of 5,600 kg and a skip velocity of 20 m/s. The 2 x 540 kW mine winder DC motor from Siemens & Halske was used in the colliery for over a half century. Nowadays, the entire, fully functional unit is one of Germany's major industrial monuments.

In the next 30 years, a DC drive with the Ilgner converter was the prevalent







adapt to any environment. The Pulse-Width-Modulation (PWM) converter with water cooling for dynamic, regenerative synchronous motors enables a higher torque. The converter is even able to operate during major power

has a capacity of 3,000 kW and a winding speed of 14 m/min. The upgrade was completed as quickly as possible during production downtime. To expedite the process, the hoisting motor is delivered fully pre-installed in

#### Siemens' technical achievements in mine winder technology:

1936	Implementation of a mercury vapor converter
1968	First thyristor-controlled mine hoist
1973	Implementation of the first electronic speed controller and signal pillar
1973	First SPS control system
1980	First reference of a variable transmitter on a microprocessor basis for jerk-limited acceleration and slowdown
	First mine hoist with a cycloconverter
1986	Implementation of a fully digital monitoring and control system
	First integrated mine winder engine
1990	First mine hoisting machine with adjustment of the jerk to the resonance frequency of the system for the prevention of rope vibration
1998	First remote control desk
2001	First mine hoisting machine with PLC-based control technology
2005	First mine winder with a synchronous motor with a PWM converter
2008	Multi-channel constant retardation brake system
2010	New economical control desk design
2012	Stand-alone digital supervision system

technology for bigger mine hoist systems. From the beginning, Siemens has been a pioneer in drive and control technology for mine winders.

### Siemens – all bases covered

Today, shaft hoisting systems have evolved in regard to the type of motor (integrated in the rope sheave, or a conventional layout with a lateral synchronous or high-speed inductive motor) and the type of converter (PWM converter, cyclo- or DC converter). Siemens is one of the few suppliers worldwide that offers all possible combinations of drive and converter in its Simine Winder product line.

The integrated machine features a synchronous motor functioning as an external rotor installed in the drum hoist. This has proven to be a successful model in many pits for over thirty years; it is used in particular where there is limited space in the engine rooms and where an even, symmetrical load on all systems is required. If top performance at minimum expense is the order of the day, then a cycloconverter is the ideal solution. Thanks to its air-cooling function it is able to

fluctuations. Whichever Simine Winder combination is selected, the solution contains the integrated Winder Technology Control-Unit (WTC) based on the tried-and-tested Simatic S7 automation system.

### Innovation built on 110 years of experience

In the Tunliu mine in China, Siemens installed two high-powered skip hoists with synchronous motors, each with an installed capacity of 4,000 kW, and feed Simowert ML II (PWM) converters. This is the perfect system for mines with relatively poor power supply. Compensation and filter units are not required.

For the world's largest nickel producer, MMC Norilsk Nickel, the mechanics and electrics of the two skip hoists were fully upgraded and automated. The conventional hoist motors have a capacity of 4,600 kW each and are fed by Simovert D 12-pulse cycloconverters.

At the K+S KALI site in Hattorf, Germany, Siemens replaced the old hoist with a single-rope sheave with an integrated motor. The machine, fed by a Simovert D 12-pulse cycloconverter,

the sheave and mounted on the pre-assembled foundation.

Recently, two of the four machines with integrated 9,000 kW motors – the biggest ever supplied by Siemens – were installed in the colliery of Yitai Group in China. The extremely compact design of the integrated hoisting machines designed by Siemag together with Siemens will help the Yitai Group to reduce their investment costs when building the new colliery.

Siemens is prepared to support the mining industry with continuous technical development – for example in regard to power quality, efficiency and network feedback – in order to explore new horizons in mine hoisting technology. And for the future, Siemens is set to support the mining industry with modern and reliable automation solutions to achieve maximum safety in mine operations. ■

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SAG mill drive system

# African mine gets a tailored solution

In 2011, Outotec invited Siemens to tender for a mill drive system to run an 8.3 MW SAG mill in Africa. The brief: supply a system that could operate reliably in a harsh environment, was easy to maintain, and could be accurately controlled within its operating parameters. In the end, Siemens came up with a solution that perfectly fulfilled these requirements.

**W**hile the technology is available to produce 8–9 MW via a single pinion, Outotec decided to run this mill in a twin-pinion configuration. The project scope encompassed all the equipment between the 22 kV bus and the mill pinion, so Siemens tendered for the design, manufacture, factory test, packing according to ISPM 15, and delivery to Durban, South Africa, of a complete twin-pinion, variable-speed mill drive.

## Dependable mill control

There are plenty of applications in the mining industry these days – such as pumps, fans and conveyors – that apply variable-speed drive technology for either process control purposes or to overcome high starting torques. Most of the application-specific requirements have over the years been implemented in the drive control via macros and have become straightforward and less

of a challenge. Grinding mills, on the other hand, are complex applications with a variety of variables and various auxiliaries – such as lubrication, braking and cooling systems – that require an engineered solution. The inherent high inertia of the mill develops load torques of up to 150% of nominal torque during startup and experiences dynamic load changes during operation, which require an accurate and responsive yet sturdy speed control system.



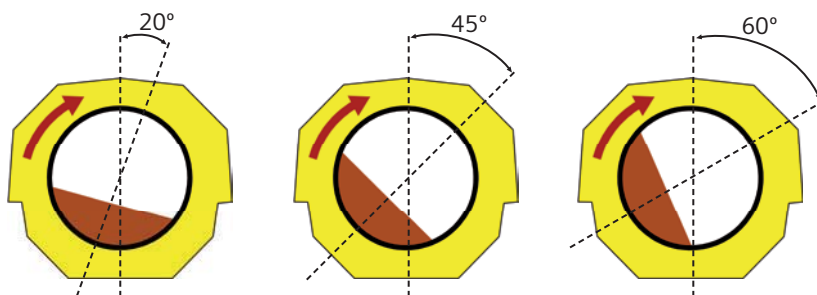
The Mill Controller (MC) from Siemens with its specific software algorithms turns a standard Sinamics GM150 or GH180 Perfect Harmony Drive into a mill drive. In addition to on-the-fly Frozen Charge Detection, mill positioning and automatic balancing, the MC also ensures accurate load sharing (typically < 0.5% dynamic speed error) and controls smooth starting and stopping of the mill.

## Mill drive system

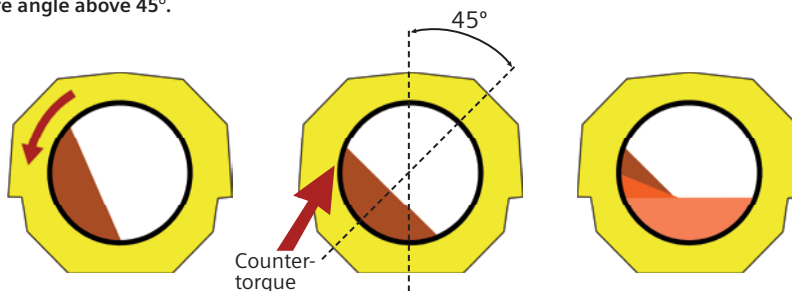
For this project, Siemens supplied an 8.3 MW mill drive system consisting of two air-cooled Sinamics GM150 drives and motors in a twin-pinion configuration. In order to inch and creep, the drives needed to be operated at speeds below 10 Hz for prolonged periods. In general, IGBT-based MV drives have less than 80% of the drive capacity available if operated below 10 Hz, so the twin-pinion system had to be oversized considerably. Despite an actual load requirement of 8.3 MW for the whole mill, the drives were sized to deliver 10.1 MVA on each pinion continuously – 20.2 MVA in total – offering the necessary dynamic performance and high overload rating (150% overload for 60 seconds at start) that can be expected from an SAG mill application.

## Frozen Charge Detection and Protection

After the start command, the mill is first ramped up to “inspection speed” – which is 10% of nominal speed – to perform on-the-fly Frozen Charge Detection. Maintaining inspection speed, load torque and mill angle are closely



In Frozen Charge Shaker™ mode, the motor first rotates the mill until the charge arrives at a safe angle above 45°.



The mill is then left to roll back to 45°, where it is stopped abruptly by applying a counter-torque of 130%. The impact of the counter-torque in the charge usually causes the charge to slip. If the charge continues to be attached to the mill shell, the process is repeated in the other direction.

monitored. Under normal conditions, the mill charge starts cascading above an angle of about 40–45° and the load torque decreases. In that case the mill completes a full quarter rotation to 90° and is then accelerated to nominal speed.

If the load torque keeps increasing past a mill angle of 75° to 80°, frozen charge is very likely, and the mill is stopped immediately to prevent the charge from dropping and causing damage to the mill shell and bearing pads. To remove the charge, Siemens has a patented feature as part of the MC – the Frozen Charge Shaker™ – which helps loosen the charge from the mill shell.

## Controlled stop

After a stop command, the mill speed is decelerated along a predefined ramp until it has come to a complete stop. At this point, the charge is typically up on one side of the mill and applies a negative load torque on the brakes. Mill balancing slowly rolls the mill backwards until the charge reaches equilibrium and no load torque is present. Without a controlled stop, the mill would coast to stop, eventually ending up rocking to either side causing unnecessary mechanical wear and tear, which can lead to reduced equipment lifetime and increased maintenance.

## Key interlocking system

As standard, the offered Sinamics GM150 comes with an electrical door interlock that inhibits access to the drive as long as the DC bus voltage is above 50 V. For this project, however, Outotec had asked Siemens to implement an additional layer of protection in the form of a mechanical key interlocking system. One purpose of the system was to prevent access to the VVVF drives while medium voltage is still present. This is achieved through interlocking the drive cubicle doors with a key from the upstream CB. The other purpose of the system – which Outotec was very adamant about – was to ensure that the main mill drive system cannot be started up while the inching drive on the gearbox is still engaged. For this, a key was mounted on the inching drive lever.

## Summary

The all-Siemens mill drive train was executed as a total integrated package and successfully commissioned to Outotec and the end client's full satisfaction. ■

### The system delivered by Siemens to Outotec:

- 22 kV SF6 insulated NXPLUS C switchgear
- 2 x 5500 kVA ONAN step-down transformers
- 2 x 4.15 MW (10.1 MVA) @ 4160 V VVVF Drives (Sinamics GM150)
- 2 x 4.15 MW @ 4160 V SCIM
- 2 x MDSS01 single stage gear units

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Freeport mine in Papua, Indonesia

# Concept proves its value again

A solution for underground mining logistics featuring Simatic PCS 7 is being transferred from Sweden to Indonesia.



## Midroc Automation

Midroc Automation is a part of Midroc Europe, which is a comprehensive partner in the areas of properties, construction, industry and environmental technology. The company's goal is to make its customers more competitive and to contribute to a better future through the implementation of sustainable solutions and innovation. Midroc Automation's operations are international, with Sweden as its base. Siemens and Midroc Automation enjoy a partnership built on many years of cooperation. Midroc Automation is a Solution Partner for Simatic S7, Simatic HMI, Simatic NET Specialist, Simatic PCS 7 Specialist, Process Instrumentation, Drives & Motion, and Drives and Motion Control for Cranes and Mining.



**A**side from their remote locations, the Kiruna mine in northern Sweden and the Grasberg mine in Papua, Indonesia, appear to have little in common. The Kiruna mine is 600 meters below sea level, Grasberg is high in the mountains at over 4,000 meters above sea level. Kiruna is subjected to extreme winter temperatures, while in Grasberg the thermometer hovers around 25°C all year round. Iron ore is excavated in Kiruna, and in Grasberg it's gold and copper. One essential thing, however, that these two mines will soon share is Simatic PCS 7 from Siemens for their distributed control system (DCS) for underground operations.

The Grasberg mine, owned by Freeport-McMoRan Copper & Gold Inc., contains the world's largest gold deposit and third largest copper deposit. Until now the site has been mined as an open-pit mine, but the open-pit mine cannot be made any deeper and operations must now go underground. The mining company wanted a proven concept for its under-the-surface operations, so management selected a total integrated logistics solution for underground ore transportation, nearly identical to that which Midroc Automation installed in the Kiruna mine in Sweden.

At the Kiruna mine, owned by Luossavaara-Kiirunavaara AB (LKAB), Simatic PCS 7 controls 7 locomotives with 21 ore wagons, each sized to manage production of 35 million tons of ore per year. Simatic PCS 7 is also connected to large monitors and overhead contact systems, and it controls doors and gates for the process control system. For Grasberg, the scope is larger – to date, one and a half times larger than Kiruna. Furthermore, the solution requires adaptation to local conditions. By choosing a proven concept, Freeport-McMoRan will be able to minimize production loss in the transition from open-pit to underground mining while still getting a reliable and safe facility with world-class productivity.

## Personnel safety a priority

Since the entire underground operation is remotely controlled and delivers ore via driverless trains, personnel safety is increased. Safety is also ensured by Safety Matrix software from Siemens, which connects the machines to the Simatic PCS 7 system. The Safety Matrix itself is connected to the failsafe input and output modules and frequency inverters. Everything will be monitored from the control

room, to be housed in a three-story building with big screens. With the Midroc Automation solution in place, Grasberg will become the world's most high-tech underground mining operation.

So that the project in Indonesia runs as smoothly as possible, Midroc Automation's site manager in Papua is Anders Borssén, who was also the site manager in Kiruna. "It is a great experience to be part of these two projects," he says. "The goal is to implement every new project in a better and more efficient way than the last, and I already feel that we have taken the next step in terms of our new project here in Indonesia."

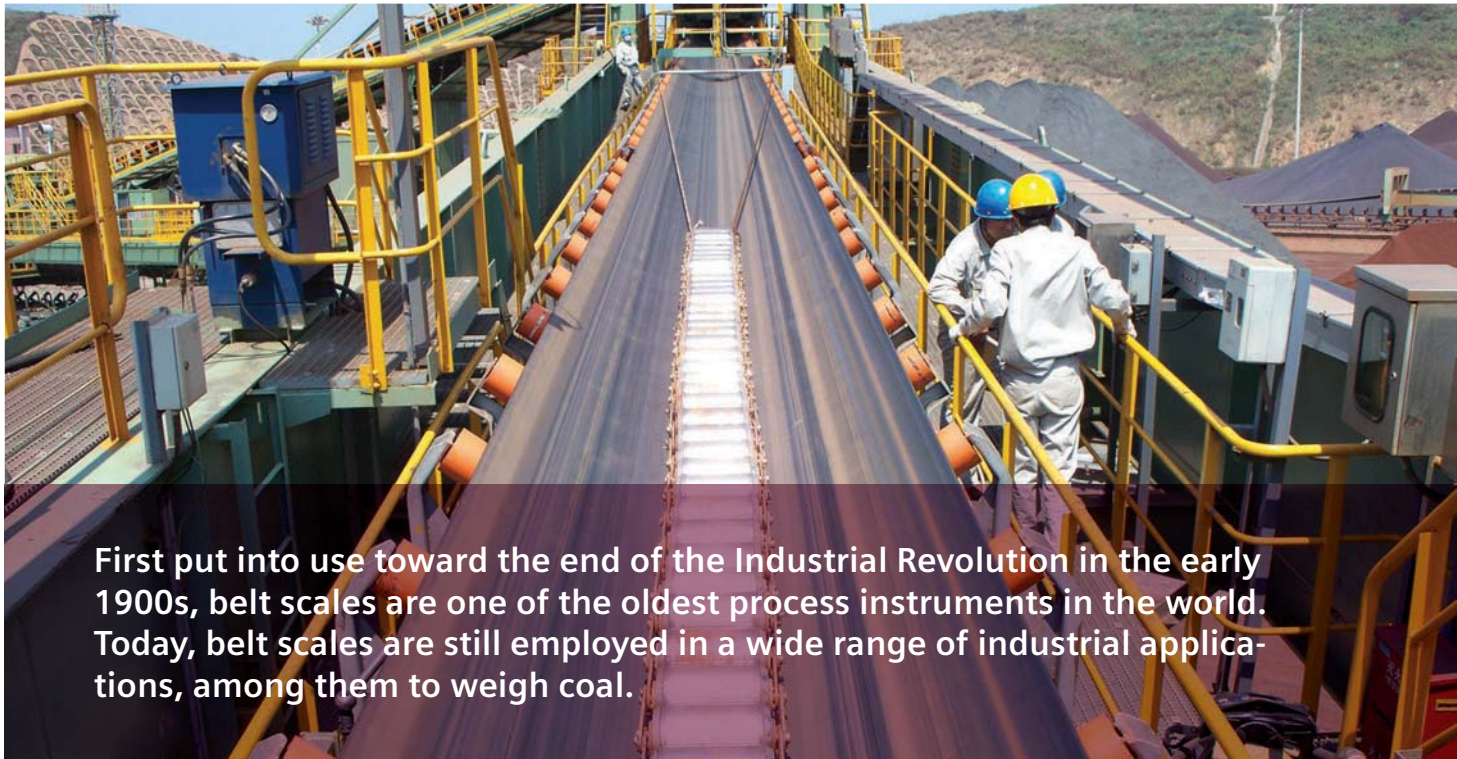
So far, Midroc Automation's contract at Grasberg is expected to be completed in 2017. Midroc Automation, however, hopes to stay in the area for far longer by establishing a base in Indonesia. Chances look good for further Midroc Automation projects featuring Simatic PCS 7 – not only in Asia but also in the rest of the world. ■

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## The use of Milltronics MMI belt scales in a coal mine

# Accuracy makes the difference



First put into use toward the end of the Industrial Revolution in the early 1900s, belt scales are one of the oldest process instruments in the world. Today, belt scales are still employed in a wide range of industrial applications, among them to weigh coal.

**G**DF Suez is one of the leading power producers in the world. Among their many operations is a coal-fired power plant located in Nijmegen, the Netherlands. The coal that fuels this plant comes by ship from around the world and it is unloaded at the Mass-Waal Canal in Nijmegen. A grab unloader lifts up to 50 tons of coal and deposits it in a hopper. The coal is then moved onto a conveyor and transported to the stockyard, where a stacker-reclaimer creates stockpiles. Conveyor belts equipped with belt scales then carry the coal into bunkers, where it awaits transport into the furnace.

GDF Suez pays for each coal shipment according to weight. If scales do

not perform correctly, the power company may have to pay for more coal than was delivered. Furthermore, the plant also endeavors to optimize its consumption of coal, ensuring that inventory amounts remain adequate so that the furnace can be continually fed. For both tasks, belt scale accuracy and reliability are essential.

The company relies on technology from Siemens for this critical task. Siemens' Milltronics MMI trade-approved belt scales, which, combined with a Milltronics BW500 integrator and Sitrans WS300 speed sensor, provide 0.25% accuracy. The MMI has a compact design that allows for short idler spacing typically found on compact conveyor belts. The load cell's

triple-beam-parallelogram-style design allows for direct load transmission from the idler. It is unaffected by shearing forces generated by start-stop operation of off-track running.

Because of the load cells' fast response times, the MMI belt scales are highly accurate, even when flow rates fluctuate. They can be used on systems with rates up to 12,000 tons per hour (tph). In Nijmegen, coal is fed into the furnace at 220 tph. GDF Suez technicians monitor the entire process – from unloading to storage, to feeding the furnace and beyond – from the control room using the Simatic PCS 7 control system. An important aspect for belt scale accuracy and performance is regular calibration.





Far left: Siemens Milltronics MMI trade-approved belt scale measures incoming coal with an accuracy of 0.25%.

Left: With Siemens Simatic S7 control system, technicians monitor the entire power generation process from the comfort of the control room.

## The evolution of calibration

Since the introduction of belt scales, their design has evolved, with each design requiring a slightly different calibration technique. The first scales were mechanical devices that measured the total amount of material conveyed. Their levers and gears were fairly difficult to set up and maintain. Once the load cell came into the picture, however, scales radically changed. Using electrical signals instead of pivots and bearings meant much simpler designs and configurations. New belt scales – similar to that of the Milltronics MSI and MMI from Siemens – directly load the cells with the weigh idler, ensuring that weight is supported by the cells instead of levers or springs. Capacity has also radically changed since the first scales: some mines now have flow rates of up to 20,000 tons per hour – an amount unheard of 100 years ago.

GDF Suez's stacker-reclaimer creates stockpiles of coal after it is unloaded from ships in Nijmegen's Maas-Waal Canal.



## Choosing the right tool

Siemens offers various ways of calibrating belt scales: weights, flat bar weights, high tolerance weights, manual and motorized weight lifter/storage devices, test chains and chain storage devices. The Milltronics BW500/L, Milltronics BW500, Siwarex FTC, and Siwarex WP241 can also calibrate electronically.

The question often arises as to which type of calibration technique to employ. Generally, weights are acceptable and achieve 0.5% accuracy, providing that guidelines for installation are followed. Chains are a good alternative if a material test cannot be performed to verify calibration, and they

are recommended for applications requiring accuracy greater than 0.5%. Electronic calibration has become popular as the performance of load cells has improved, but it is still typically only used in non-critical processes.

Another important aspect is the frequency of calibration. As a guideline, belt scales should be zeroed at least once a week, though frequency may need to change depending on the accuracy required. Furthermore, weights should undergo a span calibration at least once a month. Siemens recommends selecting weights with 25% to 60% of the design load. However, with today's improved load cell linearization and loads being directly applied to the cells, it is

likely that calibration at 25% to 40% will become the norm.

## Timely as ever

To ensure optimized material feed in a power plant or other large-scale facility, it's essential to have a solution that can manage the job. For over 100 years, belt scales have proven their value in thousands of installations worldwide. To keep up accuracy and reliability, a suitable calibrating approach has to be taken. ■

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As mineral ore qualities deteriorate, it has become necessary to excavate larger and larger quantities of ore. This, of course, means higher volumes to transport. To find the optimal solution, topology, transport volumes and distance must all be taken into careful consideration. Siemens offers a number of solutions, which have proven their value in countless installations.





Bulk transport in mining

# Moving more with less

better infrastructure. At the same time, with dwindling ore content, more and more minerals must be excavated in order to cover the industry's needs. As a consequence, an increasing volume of rock has to be transported over extensive distances from the extraction site to the processing plant. Looking into the future, conveying capacities of 40,000 tons per hour and above can be expected. The costs of logistics between a mining company's sites can become a major factor for competitiveness, and one which should be taken into consideration right from the planning stages in mine construction.

Naturally, every transport system has advantages and disadvantages, depending on a number of factors: the topology of the site, the distance to the deposits, the power supply, the environmental conditions, the regulatory framework, and not least of all the capacity required of the transport equipment and the properties of the bulk material. When selecting an appropriate transport system, further important criteria include efficiency, availability, reliability, investment costs and operating costs. At the moment there are a number of different systems on the market. In the end, they fit into one of two categories: continuous transport or discontinuous transport. ►

**F**or centuries, mineral ores have been mined at sites all across the globe. At first, these were pure ores that could be simply found in the ground. But with time and the growing desire for more and more metals, the search has gone deeper into the earth's surface and

higher into its mountains. Today mines are mostly in barren terrains, far from civilization and infrastructure.

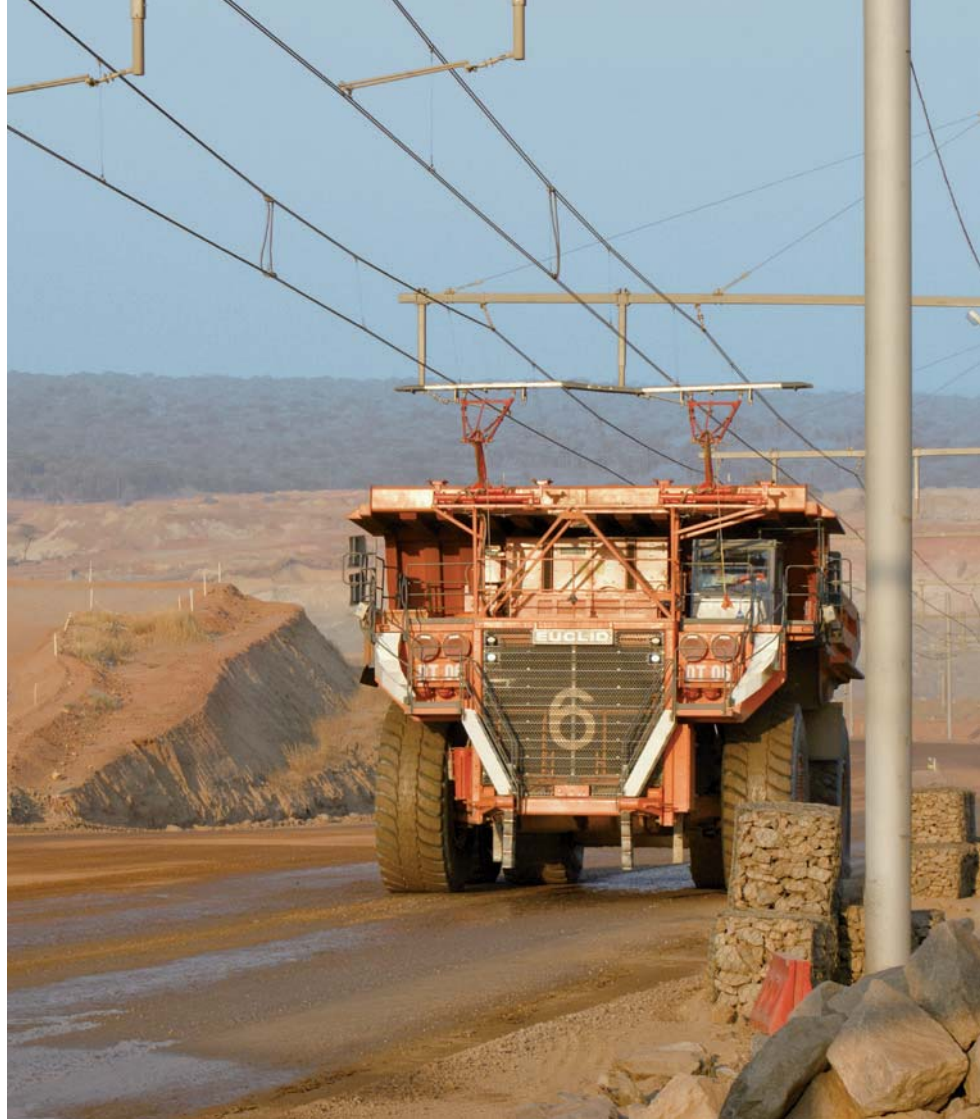
The material excavated at these mines generally has to travel long distances to processing sites, mostly built in areas where there is more space and



## ► Truck and truck-trolley operation

Trucks currently dominate the area of discontinuous transport, particularly in hard rock mines where transport with trucks is the most common method. To achieve higher capacities, there are basically three solutions: larger trucks, a greater number of trucks in the mine, or higher speeds. In regard to larger trucks, the tires would be the main limiting factor, as they can carry only a certain amount of weight. Conversely, a higher number of trucks could easily lead to congestion on busy road stretches. The best remedy, therefore, is a significantly higher transport speed. Today, trucks have either a purely mechanical design, typically up to 200 tons capacity, or are equipped with diesel-electric drives and have a capacity of up to 500 tons. Truck-trolley systems can offer valuable assistance by providing additional drive power, especially when going up steep ramps, where trucks without trolley support typically only travel at speeds of around 10 km/h. DC-powered overhead electric lines, such as those used by trams, provide the diesel-electric driven vehicles with the extra drive power. Higher speeds become possible, so more ore can be transported without having to increase the truck size or the number of trucks in the mine. As a rule of thumb, typically the speed of the trucks going uphill under trolley line operation almost doubles compared to non-trolley operation. And at the same, the diesel engine only idles and reduces fuel consumption to almost zero. At the crusher or at the dump, the trucks can be operated flexibly without overhead lines.

Operators at the Lumwana mine in Zambia, which has a yearly production of almost 17,000 tons of copper, chose the truck-trolley system for ore transportation. The chief driver for the Lumwana mine was optimization of CAPEX and in particular OPEX, because fuel and electricity are the main cost factors. Space considerations played a secondary role. With the truck-trolley system the trucks were faster on ramps – to such an extent that truck fleet could be reduced. In the end, by selecting this transportation concept CAPEX (the size of the truck fleet) and OPEX (higher productivity, fuel savings, less maintenance) could be reduced. The same technology behind the truck-



*Expert knowledge gained over the years allows Siemens to assess the individual needs of each location and suggest the most suitable solution for the job.*

trolley system can also be used outside the mine: While for long routes railway transport is the mode of choice, for middle distances Siemens offers special e-trucks with hybrid drive. These trucks can travel on any road that is equipped with a two-wire catenary system. The truck's drive system consists of a diesel engine with a generator and electric drive for independent running, as well

as a patented trolley system that ensures electricity supply over long distances.

### Proven belt conveyor systems

For continuous transportation, the key to moving more material is an increase in transport capacity through greater drive power. With more powerful drives, higher belt speeds and larger belt conveyor





systems, more bulk material can be moved. A number of tried-and-tested belt conveyor systems are available to transport bulk material over varying elevations and distances. The most common system is the conventional belt conveyor.

Conventional belt conveyors are to be found wherever large material flows have to be transported over long distances. The technology for these systems

has been perfected, and it is now possible to achieve greater transport capacities with increasingly powerful drive solutions. Siemens collaborated with ThyssenKrupp to develop direct drive systems for conventional conveyors, and direct drives can be designed up to 9 MW. Not only does this save space, it also increases availability thanks to fewer mechanical components such as bearings, gearboxes and couplings. Furthermore, these direct drive solutions are better in efficiency.

The belt conveyor system with direct drives at the Antapaccay Copper Mine in Peru transports ore from the mine to the processing plant over a distance of 6.5 km. The design parameters are 5,260 t/h at a speed of 6.2 m/s. The system was chosen because – at a similar investment cost compared with a conventional geared conveyor solution – a series of mechanical and electrical components could be eliminated. Availability automatically increases and less maintenance is required. Furthermore, with a direct drive system drive stations can be built more compactly. The efficiency of the entire system increases 3% to 4%, since gear and other losses are eliminated. Longer belt conveyor systems are conceivable, and the number of drives and transfer stations can be reduced.

### Flexibility for all terrains

Aside from conventional belt conveyors, Siemens also offers solutions for pipe conveyors and specialized belt systems. Pipe conveyors take on fine to coarse bulk material like any conventional belt conveyor and then close into a circular cross-section. These conveyors can handle fragment sizes of up to one-third of the pipe's diameter. The pipe conveyor can deal with curves relatively well, and it can be optimally adjusted to the topology at the mining site.

In the cable belt system, a belt is suspended between two cables, which are driven by pulleys. This system is well suited for covering long, curved routes. Finally, the RopeCon system combines cable pulley technology with a belt conveyor solution. This model is suitable for major changes in elevation and unpassable sites. It requires few support bases and can convey high flow rates. During downhill motion from the pit to the dropping point, both systems can oper-

ate generatively to feed energy back into the power supply.

### A benchmark conveyor system

The coarse ore conveyor system in Minera Los Pelambres, Chile, commissioned in 1999, relies on conventional belt conveyor technology. To this day, it is still considered the benchmark for downhill operating belt conveyor systems. This belt conveyor transports copper ore from the mine at an elevation of 3,200 m down to the processing plant at 1,600 m. Initially designed to handle 8,700 t/h, the system's capacity has since been increased to transport 11,000 t/h. The installed drive capacity of the three belts amounts to 25 MW, while approximately 18 MW of electric energy is fed back into the power grid at nominal belt load.

The operator selected continuous conveyance, primarily due to the mine's layout. Firstly, there was not enough space for a processing plant at 3,200 m, and secondly the logistical costs for constructing and servicing the site were substantial. Another advantage of the solution is that electrical energy is generated while transporting the copper ore, which allowed for a quick amortization of the investment costs.

### Tailor-made solutions

Siemens offers well-thought-out drive systems for all conveyor applications. Mechanical construction is simple and robust, and the drives are combined with modern converter technology as well as proven automation and control. The result is economical operation of large conveyor systems that are able to transport larger and larger volumes of ore. Siemens' first delivery to the mining industry was a mine winder in 1903, and since then the company has become a trusted partner of the mining industry. Expert knowledge gained over the years allows Siemens to assess the individual needs of each location and suggest the most suitable solution for the job. ■

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Energy efficiency, retrofitting and financing

# Maximum efficiency with minimum risk

Energy Performance Contracting is the intelligent way to realize energy efficiency projects.

**A**s energy costs rise and environmental standards become ever stricter, cement factories are increasingly interested in tapping energy-saving potential. With Energy Performance Contracting from Siemens, operators can now finance all measures required with the savings achieved.

Producing cement clinker is an energy-intensive process. On the one hand, there is the large carbon footprint, which will incur additional costs in the future under the global emissions trading system. On the other hand, energy costs are high – and rising continually. It is therefore all the more important to exploit energy-saving potential through targeted modernization and optimization in order to reduce operational costs. Plant managers face the challenges of securing advance financing and risking a bad investment. An answer to these challenges is Energy Performance Contracting. The customer does not require an investment budget to realize their project, and the installments agreed upon in the contract are paid off from the savings achieved. In addition, the modernized facilities undergo regular inspections throughout the duration of the contract, which ensures

assets retain their value during the stipulated period and beyond.

In initial applications in industrial settings, Energy Performance Contracting has already proven to be an effective instrument for ensuring environmental protection and operating efficiency, while safeguarding the future of a business location – a win-win situation for all concerned.

## Transparency trumps

A central element of Energy Performance Contracting is the transparency it offers concerning the anticipated savings. The contracting installment is paid out of the energy savings achieved in subsequent plant operations. To reduce project risks, the model comprises three stages: identifying the main consumers, defining the potential, and decisions/realization. If during the preparatory phase the anticipated energy and cost savings are determined to be infeasible, the customer is entitled to terminate the project before the implementation phase free of charge.

The drive technology in a cement factory consumes over 90% of electrical energy used in all applications. For this reason, it is generally possible to

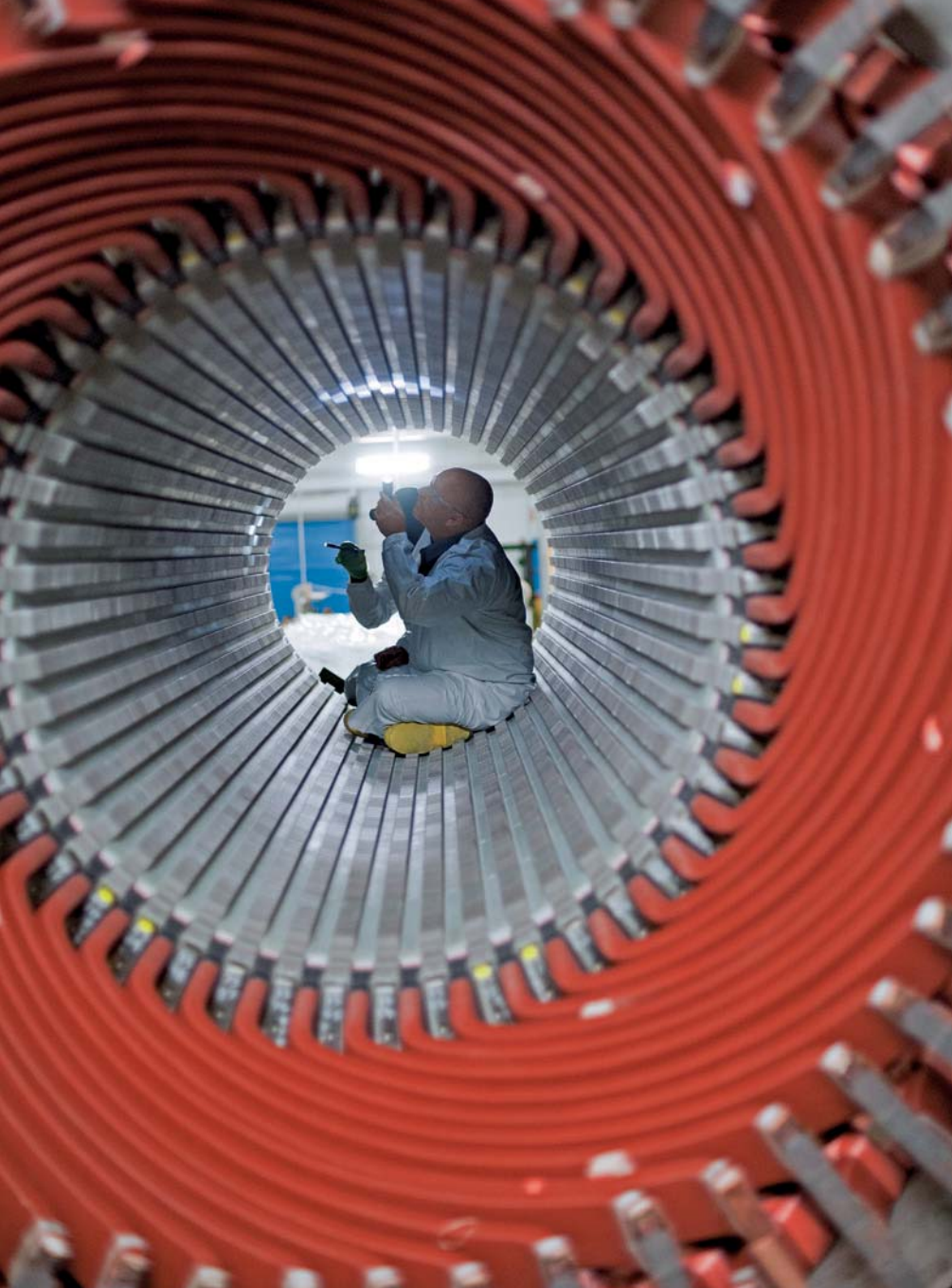
achieve considerable savings in this area in a short period of time. Savings potential is particularly high in long-serving ancillary units such as pumps and ventilators. Simply reducing the drive speed can result in considerable energy savings. A further option is to replace old motors with new, high-efficiency IE2 or IE3 motors. Siemens' experience in industrial projects shows that this can secure savings of up to 30%.

## Steps to profitable savings

To get an idea of the modernization and financing measures required, Siemens experts first of all complete an assessment of the plant based on data provided and a site inspection. This gives an initial overview of energy consumption and of the actual energy costs. Using this information, an optimization plan is compiled as part of an overall energy assessment. This suggestion takes into consideration the maximum acceptable amortization period and determines how high the contracting installments can be while still ensuring the minimum savings desired. The results are used to draft a preliminary contract for the energy performance scheme.

In a second phase, a precise analysis and evaluation of current energy con-





sumption is performed. This involves, for example, checking data for the list of motors on site and verifying it with measurements. This step makes it possible to detect inefficient drives and to develop appropriate optimization measures. A clearly defined energy-saving concept then forms the basis for the main service level agreement for the energy-saving project.

Once the contract has been signed, the third project phase begins and the technical optimization measures are carried out. At the final inspection, the actual savings achieved by the project are measured and compared with the baseline situation. If the agreed-upon

targets are not met, Siemens offers a lump-sum compensation payment. Otherwise, this point marks the beginning of the repayment period for the installments set down in the contract.

### Planning, implementation and financing – all from a single source

A particular advantage for the plant operator is that the project is implemented entirely by Siemens, with all services provided from a single source. The work involved in coordinating technical requirements and business interests is significantly re-

duced. Siemens handles everything from identifying energy-saving potential and project realization all the way to servicing to retain asset value during the contract period. The service agreement allows for an annual inspection of the new drive applications as standard, although this can be extended according to customer requirements. ■

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# Siemens: A partner for African mines



**As a leading provider of efficient equipment to mining companies in Africa, Siemens South Africa offers a solution portfolio tailored to the region's needs. Whether for energy infrastructure or automation, Siemens engineers view the product development and production chain as a whole.**

**A**frica is well endowed with mineral resources: the continent possesses the world's largest mineral reserves of platinum, gold, diamonds, chromite, manganese and vanadium. Siemens has a proven track record in Africa's mining sector. And currently, some of the most exciting projects are being completed by Siemens South Africa, which is responsible for countries in Southern and Eastern Africa.

In general, with the exception of South Africa, many African countries have poor road and power infrastructure. In fact, providing adequate supplies of electricity is one of the conti-

nent's greatest challenges. For Siemens, this spells a big number of opportunities.

In Tanzania, for example, Barrick Africa operates three gold mines in remote areas, reasonably far from power sources. When Siemens was called to evaluate the situation, engineers found the main power supply quality to be extremely poor. The mines relied greatly on diesel engines for power generation, which represented huge overhead costs. Siemens installed a new 120 km long 132 kV line with static VAR compensators to improve quality at Barrick's North Mara site. A 120 km, 220 kV line was also laid for the Buzwagi site. Though at the moment there are more

opportunities for power supply projects like this one, contracts involving automation are on the rise.

The Lumwana Copper Mine in Zambia relies on Siemens for all of its electrical equipment, including automation. "Africa is a challenging place to operate," says Zane Berry, the Superintendent of the Lumwana Mining Company. "Therefore, mines need the most reliable solutions available." A highlight at the mine is the truck-trolley system: Siemens provided the electrics for 28 Hitachi 250-ton mining trucks, including the electrical variable speed drives as well as the electric wheel motors, each rated at 2MW. Siemens also





## A longtime partner in South Africa

Siemens' first mining project in South Africa commenced in 1867 and involved electrical locomotives for the Transvaal Mining Estate in Pilgrim's Rest. Today the focus is on helping mining operators reduce downtime and increase profits.



## Training tomorrow's engineers

Siemens gives back to local communities. The Mandela School of Science and Technology in Mvezo village, South Africa, was built by Siemens at a cost of €10 million, making it one of the company's biggest-ever social investments. The school opened its doors in January 2014. The building is a beacon of progress, featuring renewable energy sources, energy-efficient lighting, automation systems, rainwater capture and water filtration technologies. As many as 700 young people from Mvezo village – the birthplace of Nelson Mandela – and the surrounding area are being educated at the school. The focus is on engineering, science, technology and agriculture.

supplied the overhead trolley lines that supply 4 MW of electric power per truck and enable the vehicles to climb out of the growing open pit at speeds of up to 24 km/h.

### Automation lowers downtime

Anglo American uses Simatic PCS 7 from Siemens at many of its coal plants. One such plant is Dalyshepe in South Africa. In this instance, Siemens answered the question of how to control a plant remotely without using the conventional communication system, thereby lowering downtime. Standard software blocks were developed and used

throughout the software. Online monitoring made possible by Simatic PCS 7 is also profiting operations at Isibonelo Colliery, Anglo American's latest open-pit coal operation around 120 km east of Johannesburg. "The automated system from Siemens helped us reduce our costs because we have one operational controller who can see the whole plant at one time, instead of twelve people at a time taking care of different parts of the system," says James Morotoba, Mine Manager at the Isibonelo Colliery. Technicians are impressed with the system, especially because it is easy to understand and use. Mining is an important factor for eco-

nomical growth in Africa. As the examples above show, Siemens South Africa is in a position to support mines with all of their electrical and automation needs. The portfolio covers everything, from extraction and transportation to beneficiation and secondary processing. To increase productivity, Siemens looks at the entire value chain. ■

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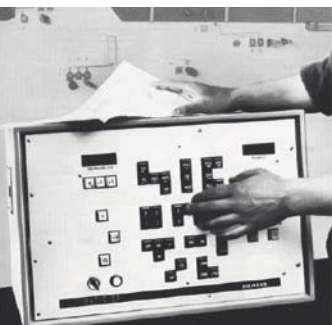
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Cemat: the leading process control system for the cement industry

# 40 years in service – and still as innovative as ever







**The greatest challenge for the cement industry is to maintain competitive production costs, despite tighter caps on emissions and rising energy prices. For over four decades, the integrated process control system Cemat has helped the industry face this challenge. The standard software from Siemens now plays a decisive role on all company levels in the cement industry, and at all stages of the production process.**

**C**emat's story of success began over 40 years ago, with a first version based on the then newly developed programmable logic controller Simatic S3. The system was first installed in Cementos Hispania's cement works in Yeles, Spain. The technical department at Dyckerhoff Group, which Cementos Hispania belonged to at the time, planned the control system and programmed the control units. The plant was commissioned in fall 1974, with support from Siemens. The installation was comprised of four Simatic S30 programmable logic controllers, and back then the first Siemens PLC was as big as a cabinet, stuffed full of electronics and magnetic core memory units.

### Step-by-step improvement

Over time, as the technology developed, the software and hardware platforms were replaced by the subsequent models Simatic S5 and Simatic S7. Although the standard modules for drives, dampers, groups and more developed for the first version of Cemat were updated from version to version over the years, the module's organization and its core functions have remained unchanged. With its innovative and forward-looking technology, Cemat now supports all leading cement plants. With over 800 installations worldwide, the system has become the leading process control system for the cement and mining industries, and for related industry branches. For decades, major companies such as Holcim, Lafarge und HeidelbergCement have used the system – increasingly as a company-wide platform.

Cemat Version 8.1, based on Simatic PCS 7, is now available, providing

cement manufacturers with a modern control system that is tailored to respond to the industry's key concerns. These include: optimization of production, process and plant performance, and transparent quality and production control. Cemat provides access to all relevant production data in cement manufacturing at a glance and in real time. The control system therefore offers plant operators invaluable help in optimizing production capacities in their cement works. A further advantage of Cemat is its integrated operational and diagnosis functions, which minimize downtime by detecting potential faults sooner.

The simple scalability of Simatic PCS 7 in terms of system size, functionality and performance ensures the optimum design for each process area. This exceptional scalability also offers plenty of space for later expansion – whether for individual machines such as crushers, mills and conveyor belts with local operating and monitoring, or for complex networked systems with central operating and monitoring at a production location, such as a processing plant or a complete storage area.

Cemat features integrated technology interfaces that can connect, for example, the Motor Control Center (MCC) and drives, energy switchgear based on IEC 61850, and intelligent process instrumentation. These may be either Siemens devices or systems from other providers. Consistent communication via bus systems such as Profibus/Profinet connects existing automation islands and links them with the control level. Products and systems can be incorporated reliably into the automation from any distance via communication-enabled devices, switches and connection modules. This increases transparency through-

out the production process, and enables consistent data management, standardized operating and monitoring, as well as consistent engineering in distributed automation structures.

### 40 years of Cemat

Cemat now also includes the Minerals Automation Standard (MinAS) as an industry-specific library. "This marks a new chapter in Cemat's story of success, as it now caters to both the cement and mining industries," explains Johannes Vorsamer, Automation Expert for Mining/Cement for PD Process Automation. "And because our process control system has always used standardized hardware and software, it also offers the utmost degree of reliability for the entire industry. These are major advantages over other solutions." After all, the lifecycle of a cement plant is much longer than the life span of any single version of a control system. For this reason, the best strategy when developing a control system is to stay innovative.

Cemat is future-proof and, with constant innovation, guarantees compatibility with older versions. The latest version, for example, is still compatible with all previous versions back as far as Version 1.8 installed in 1978. This means older PLC programs can still be run and integrated into the latest version of the process control system. It is even possible to migrate to the current and future versions without difficulty. This saves money when investing in new plant technology or carrying out system upgrades. ■

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Cemat: the leading process control system for the cement industry

# First-choice automation

The cement industry depends on Cemat – whether for new lines or to update previous versions. Some worldwide references where Cemat is implemented:



## European technology a must

A new cement line in Benin is one of the latest greenfield projects to include Cemat. The line belongs to Senegal-based Les Ciments du Sahel; the company in charge of construction was Sinoma CBMI of China. The end customer specified that it wanted to use European technology, leading to the involvement of many well-known mechanical and electrical suppliers in the project. The line operator chose Cemat based on the consistency of Simatic PCS 7 as well as Siemens' dedication to high quality and expert support. Under

a tight schedule, the crusher, cement mills and packing facility were commissioned in November 2013. In July 2014, the rotary kiln was commissioned. Repeatedly, Sinoma CBMI stressed Siemens' professional and successful project execution. Les Ciments du Sahel is planning a second line in Benin, which very well may serve as another opportunity for Siemens to demonstrate the capabilities of Cemat.

The Siemens scope of delivery:

- Around 80 automation cabinets
- Eight Simatic S7-400 control units

with a redundant plant bus

- Over 1,000 ET200 I/O cards for around 14,000 signals
- Data archival and reporting with Sicement MIS
- Kiln control system (KCS)
- Cemat software engineering for the entire plant
- Comprehensive Simatic PCS 7 and Cemat training
- Four-week factory acceptance test for software including simulation
- Commissioning over a period of eight months



## *Les Ciments du Sahel chose Cemat based on the consistency of Simatic PCS 7 as well as Siemens' dedication to high quality and expert support.*

### Expansion gets Siemens technology

Kipaş Holding is one of Turkey's fastest growing companies with investments in paper, energy, textiles and cement. As the Turkish cement industry becomes an exporter, particularly to countries in West Africa, capacities are being increased.

The KÇS (Kahramanmaraş Çimento Sanayi) plant in southeastern Turkey has therefore been expanded to include a second line: clinker production on the new line started in October 2013, and in February

2014 the cement and packaging line commenced operation. The last unit of the roller press went into service in April 2014. The complete electrical packages for line two were supplied by Siemens, including the drive systems and Cemat for fully automated plant operation. For the future, KÇS has the option of replacing the automation system on the first line – which started operation in 2008 – with Cemat.

#### Basic figures for the second line

Project period	24 months
Installation and comm. period	12 months
Installation and comm. at site	36 man-years
Cable installed	350 km
Cable tray installed	14 km
Sivacon S8 panels	300
6.3kV NXAir and 33kV 8BT2 panels	41
LV-MV G150 drives	18
LV MV motors (total 500 pcs at factory)	33
Main transformers (33/6,3kV–31.5 MVA)	1
Dist. and drive transf. (6,3 / 2,2 / 0,4 kV)	14
Lighting armatures	1,000
PLCs (PCS 7 with Cemat V7.1)	6
Redundant, MIS and WEB servers	4
Operator stations	6
I/O HW signals	5,000

### Smart replacement

Asia Cement Co., Ltd. is one of the largest manufacturing cement and ready-mixed concrete companies in South Korea. Asia Cement's Jecheon plant, established 40 years ago, has undergone a number of updates over the years. As early as the 1990s, in several phases Siemens installed the automation system in the Jecheon Plant using Simatic S5 equipment and Cemat V4. Now, on a step-by-step basis until 2018, Siemens is upgrading the complete process automation system to Cemat V8.1.

The overall plant configuration is relatively complex: it consists of production units for three kiln lines including four raw mills, three coal mills and seven cement mills, all running on the same network with a total count of approximately 21,000 I/O signals. Though the system has been in operation without any problems, the upgrade has become necessary due to obsolete spare parts, the customer's plan for a future expansion in I/O counts, and limited network transmission rates as a result of the high number of signals.

The first phase is the upgrade of the existing control system of Kiln No. 1 and Raw Mill No. 4 to Cemat V8.1. The network infrastructure is being renewed in such a way that the existing communication philosophy remains unchanged and the new Simatic PCS 7 and the remaining S5 control systems communicate with each other on the same bus.

The Siemens scope of delivery:

- One redundant server pair
- An engineering station
- Three operator workstations
- Management and Information System (MIS)
- Two sets of PCS 7 AS 410S units
- I/O modules for approximately 3,300 signals
- Fiber-optic cables and network equipment
- Engineering and project management, testing and commissioning, also on site ■

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With its narrow 4-degree beam, Sitrans LR560 (A) can measure material even in a silo's cone area, unlike radar transmitters with wider beams (B). It also doesn't experience the maintenance issues of contacting technologies (C).

Sitrans LR560

# Solid performance for solids measurement

Standing at the top of a 28-meter silo, Thomas Baptista unzips his backpack. The backpack contains a Sitrans LR560 radar transmitter for solids level measurement – and it's a backpack that has seen a lot of use lately. Baptista, who works in the MSR (Measurement/System/Control) department at Holcim Zementwerk Untervaz, is installing his sixth high-frequency radar on the company's solids material silos.

Holcim Zementwerk Untervaz produces 800,000 tons of Portland

cement each year. Efficient production requires accurate and reliable knowledge of raw materials such as limestone, bonemeal and iron sulfate, among others. However, taking measurements is not always easy.

## Reliable level measurement

Holcim's quarry features a limestone pass, basically a vertical shaft through the mountain. The pass is filled with crushed limestone that acts as a buffer to ensure the continuous feed of raw

material. The pass is 80 meters high and fairly narrow, and its walls are not straight, making it hard to measure material inside. To ensure continuous operation of the 24/7 plant, it's important to ensure that enough limestone is in the pass at all times. Reliable inventory management is key. An inaccurate reading – one indicating a high level of limestone when it is actually low, for example – can cause costly delays in production.

The previous radar transmitter used to measure the materials had difficulties with these walls, and operators had



to aim the device so that it pointed at material without reflecting off the sides of the pass. After trading this transmitter in for the Sitrans LR560, Holcim immediately saw a difference in the quality of the measurement. The narrow beam is well suited for complex geometry such as that found in the limestone pass, and it provides reliable and accurate level readings.

Holcim also stores bonemeal, an alternative source of energy for cement production, in a 10-meter high steel silo. This environmentally sustainable fuel source is used in the cement kiln, the area that consumes the most energy in the production process. At first, Holcim used guided wave radar to measure the level of bonemeal in the silo. However, buildup would collect on the transmitter cable. And if the device was not cleaned regularly, the reading would show higher-than-actual levels. If not monitored properly, there was the risk that the bonemeal would run out. Here too, the Sitrans LR560 non-contacting

radar transmitter proved to be the solution. It could be installed and set up in a matter of minutes, thanks to Quick Start Wizard. Now, no buildup plagues this device, and technicians do not need to spend any time cleaning it. "Sitrans LR560 works on applications where previously we couldn't find anything else that would operate reliably," explains Baptista.

Other areas in the Holcim cement works profiting from Sitrans LR560 include the finished cement silos, the iron sulfate silo and the dry sewage sludge silo. These application areas also speak for the device's flexibility: For the cement silos, Sitrans LR560's narrow beam works well in the very narrow spaces where previously, due to its dusty, sticky environment, only manual measurements in the form of an operator lowering a rope into the silo to read the level were possible. Now, with Sitrans LR560, measurements are more accurate than ever before, because the conditions in the silo do not affect the transmitter's

performance. Finally, before Sitrans LR560 was installed in the dry sewage sludge silo, a low-frequency radar transmitter had been used to measure the level of dry sludge, a device that had to be cleaned every two months. The Sitrans LR560 has been in use for over six months, without ever needing a cleaning.

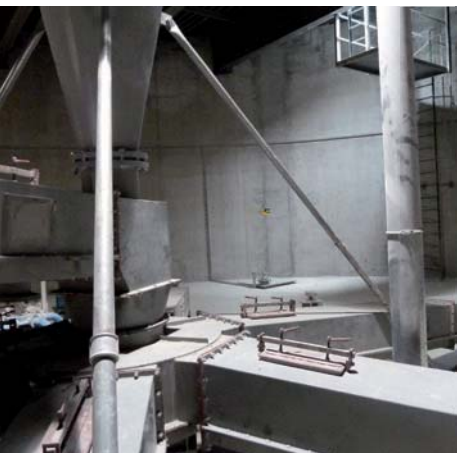
### Shorter, higher frequency wavelengths

The Sitrans LR560's operation in difficult applications can be related to a game of billiards: the angle of incidence equals the angle of reflection, meaning that the angle with which the ball hits a surface (angle of incidence) is the same as the angle with which it is redirected (angle of reflection). The same applies to a wave from a measuring device when it hits the sloped surface of a solid material. What Siemens developers have noticed while working with radar is that higher frequencies create better reflections. This is especially true for smooth surfaces and materials with small particle sizes, such as fine sand.

The standard ultrasonic or radar transmitter from well-known instrumentation suppliers in the marketplace usually contains an aiming device, which is needed to improve the signal quality. However, as the Sitrans uses 78 GHz with a very short (4 mm) wavelength, its reflection properties are significantly better than other devices. This has eliminated the need for aiming the sensor, resulting in significant savings in the installation.

Baptista and his colleagues are impressed with the Sitrans LR560. It simplifies the job of measuring limestone, bonemeal and other materials at Holcim Zementwerk Untervaz. As a result, staff can concentrate on other tasks. The Sitrans LR560 is an easy-to-install, accurate, reliable radar transmitter for a world of applications – quite a bit to fit into one backpack. ■

**The Sitrans LR560 has proven its value in a number of applications at the Holcim cement factory in Untervaz, Switzerland, where it is used for reliable solids level measurement. Quick installation, the ability to withstand dust and sticky environments, and insensitivity to buildup are just some of the device's many advantages.**



Small in size, big in performance: the Sitrans LR560 can be easily installed on any available nozzle.

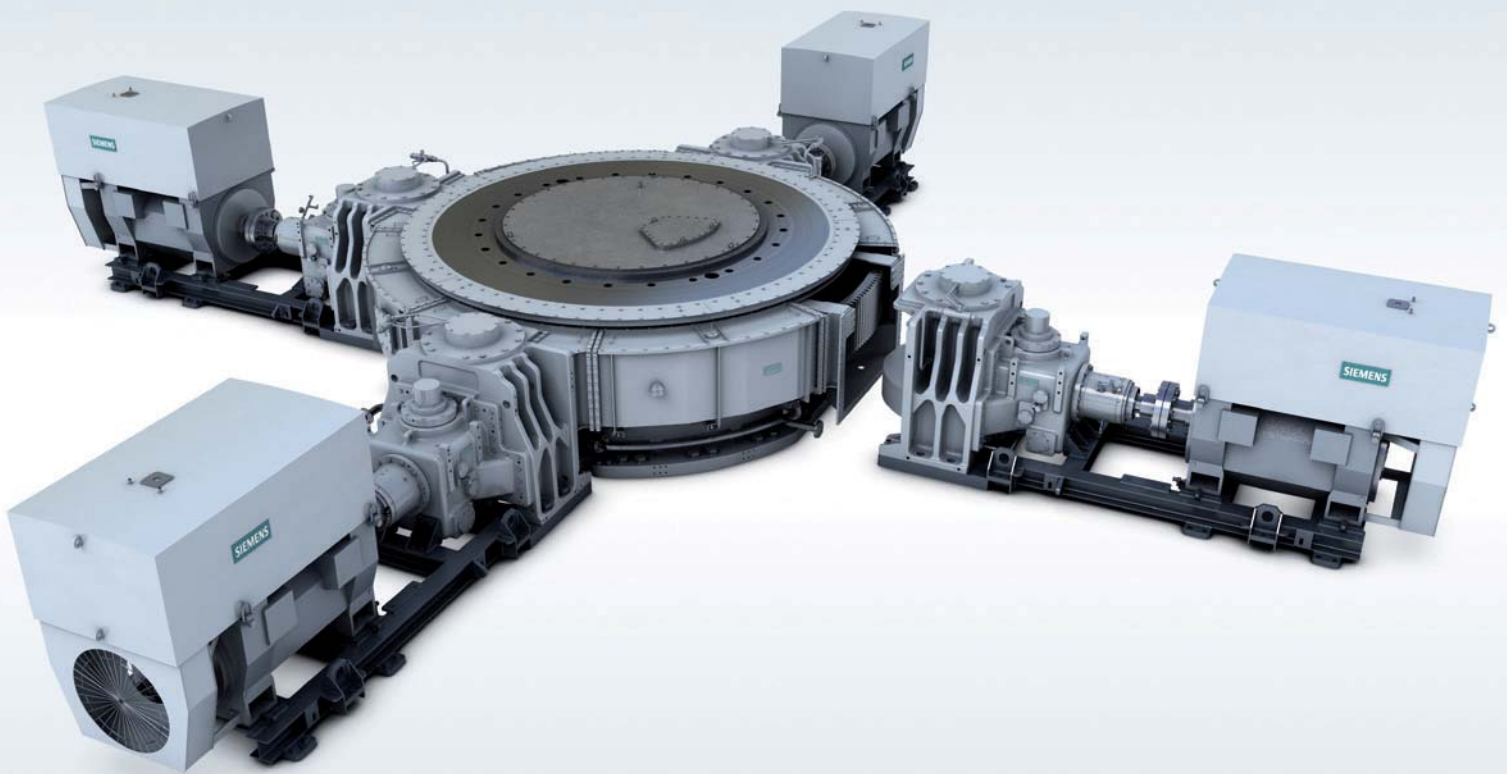
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MultipleDrive for optimum plant availability and productivity

# Not just larger, higher reliability and availability too

Siemens has collaborated with Gebr. Pfeiffer SE, a renowned manufacturer of processing plants, to develop the new Flender MultipleDrive drive system for cement mills. At a plant in Brazil owned by cement manufacturer Holcim, the system will soon be driving the world's most powerful vertical mill. The solution ensures optimized availability and productivity.





**W**ith the addition of a new MVR vertical mill, Holcim will greatly increase production capacity at its Barroso plant in the Brazilian state of Minas Gerais. The company was looking for a milling and drive concept that would guarantee high throughput rates, exceptional reliability, and as little downtime and loss of production as possible. However, because the throughput rate depends on the torque applied, it is not possible to simply increase the size of a conventional planetary gear unit as required. A solution is to apply force across the entire girth gear. To achieve this, a

Pfeiffer–Siemens team developed the Flender MultipleDrive concept. Between two and six identical drive units, each with an installed drive power of up to 2,100 kW, drive the grinding table via a girth gear located beneath the table. The decentralized design means it is possible to apply even more powerful drive units if required. This enables a system design with a drive capacity of currently up to 16,500 kW. Previously, the mechanical limit for conventional plants was 8,000 kW.

### A new concept for more power

At the Barroso plant, six drives will apply a total power of 11,500 kW to the girth gear. Each drive unit consists of an electric motor, a coupling, and a combined spur and bevel gear unit mounted on a base frame to form a transport unit. The unit is also equipped with a frequency converter, a transformer and an oil supply station. The load distribution to the individual electric motors is performed by a primary control system through frequency converters associated with each drive unit. This has the effect of minimizing torque peaks.

The drive units are installed on mounts around the milling table, offset at 120 degrees in a radial arrangement. This is a handy design for maintenance, as the units can be swung out from the mill for repair work without any major disruption to operations. The mill can still continue to operate regardless. For Holcim in Brazil, this means that the mill's capacity is still significantly more than 80% of the nominal grinding capacity.

The frequency converters adapt the speed to suit the requirements of the various mill feeds. Results show that the mill can be operated with just one single set of parameters for milling both blast furnace slag and clinker. The mill grinds various blended cement qualities with clinker proportions of up to 90% and slag proportions of up to 65% to product fineness degrees of 4,000–4,800 cm<sup>2</sup>/g according to Blaine.

"Thanks to the modular design of the drive train, a system can deliver previously unattainable performance ratings and offer far greater efficiency and availability," says Dr. Bernhard

Hoffmann, Head of Drive Applications at Siemens. In addition to this, the Flender MultipleDrive concept has also enabled cost savings of 25% on average for machines, structural engineering, electrical equipment and infrastructure, as well as significant time savings.

### Siemens as a system supplier

Siemens supplies all components of the drive train: the gear unit, coupling and the oil supply system, as well as electric motors and frequency converters. The main components in the MultipleDrive are Sinamics G150 frequency converters and Flender gear modules consisting of an H-compact PLUS electric motor, ELPEX-EFG electrical insulating coupling, a KMRS gear unit, an OWGS oil supply system, MTL grinding table bearings and an OWGM oil supply system.

The mill in Brazil will be fully integrated into the Simatic S7-300 plant control system. A maintenance tool will monitor the mill's maintenance status: Sensors on the motors, drives and mill bases will supply data on temperature, speed, torque and vibration. This data will make it possible to detect faults at an early stage and plan spare-part procurement.

### Operating experience

What tipped the scales in favor of the Flender MultipleDrive for the new MVR vertical mill at Holcim's Barroso plant was Pfeiffer SE and Siemens' positive experiences with an MPS mill with MultipleDrive in France and MVR mills in India and Australia. A modular structure, standardization and active redundancy make it possible to achieve throughput rates of up to 12,000 tons per day with a single mill solution. Initial operating figures for raw material grinding have shown very low specific wear and excellent performance after a total of 35,000 operating hours in already existing installations, while all design assumptions and maintenance concepts have been verified. ■

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## Cement expertise from Siemens India

# Riding the wave

India is the world's second-largest cement producer. In 2013, the total production was 251 million tons – though with the installed capacity, 366 million tons per annum (MTPA) is possible. Considering the ever-increasing demand of cement for infrastructure projects and the housing sector, and the major thrust and focus of the new government on infrastructure projects to boost economic growth, the installed production capacity is expected to increase substantially to 550 MTPA by the year 2020. This presents a big opportunity for Siemens India to leverage its strengths.

Siemens started partnering with the Indian cement industry in the 1980s – a partnership that continues today. Solutions from Siemens cover electrical, automation, drive and instrumentation systems, whereas multiple product ranges cater to all factory needs: automation, drives, power generation and power distribution as well as building system engineering. The range of offerings available from Siemens India for cement plants



With the gigantic cement market in India, Siemens India has grown into a veritable expert for cement projects. What's more, this expertise is also being exported to the country's neighbors as well as to other Asian, African and Middle Eastern markets.



K.C. Sharma, Vice President E & I Projects at UltraTech Cement, accepts the 100,000<sup>th</sup> motor from Dirk Hoke, CEO of Siemens' Large Drives Division.

Above: Siemens supplied an electrical and automation package for Wonder Cement's greenfield installation in Rajasthan. Pictured here is the kiln section.

Right: The pre-heater at Wonder Cement in Rajasthan. Thanks to the electrical and automation package, Wonder Cement reports stable production processes.







covers individual standalone products all the way to comprehensive end-to-end electrical and automation solutions.

Aside from serving cement producers in India, Siemens India also exports its expertise for projects around the Indian subcontinent and in the Asian, African and Middle Eastern markets.

stone with the delivery of its 100,000<sup>th</sup> IE motor to UltraTech Cement in Mumbai. Since the launch of these motors in January 2012, energy savings have amounted to 300 GWh, which is equivalent to the power required by 80,000 average Indian households for an entire year.

## Siemens India

Siemens' first project in India dates back to 1867, when founder Werner von Siemens started building a telegraph line from London to Kolkata. At the time, the 11,000 km line was the one of the fastest and most reliable telegraph links in the world. The business expanded over the years, with the production of switchgear, motors and electronic equipment commencing in 1960, 1966 and 1987, respectively. Today, Siemens in India has a sales and service network that spans across the entire country and includes 23 manufacturing plants, 8 centers of competence and 11 R&D centers. Currently, 18,500 people work for Siemens India, and every year around 200 graduate engineers join the company's ranks.



The following projects show the range of expertise delivered by Siemens India in the cement business:

### UltraTech Cement

Between 2011 and 2014, Siemens India completed a number of projects for UltraTech Cement, the largest cement manufacturer in India. Power distribution packages were supplied and executed for the 10,000 ton-per-day (TPD) plants at the company's Rajashree Cement Works (Line IV) and Rawan Cement Works (Line II), and Captive Power Plants 3 and 4 were constructed for the Andhra Pradesh Cement Works. In the same time period, UltraTech Cement commissioned Siemens to supply and execute two power distribution systems for brownfield clinker grinding units at UltraTech's Jharsuguda Cement Works and Hotgi Cement Works. A further order was filled for an automation package for a 10,000 TPD plant at the Rawan Cement Works (Lines I & II). Siemens India achieved another mile-

### Wonder Cement

Siemens supplied an electrical and automation package for a 6,500 TPD greenfield cement plant in Rajasthan, India, between 2011 and 2013. The customer Wonder Cement has since reported higher efficiency as a result of more stable production processes. Quality could also be improved thanks to well-balanced sintering conditions. The lifetime of the refractory and equipment was also extended. A further advantage is that emissions could be lowered. Siemens India has since received a new project order from Wonder Cement for the supply of an electrical and automation package for a new 7,000 TPD plant at same location. The project is presently under execution. ■

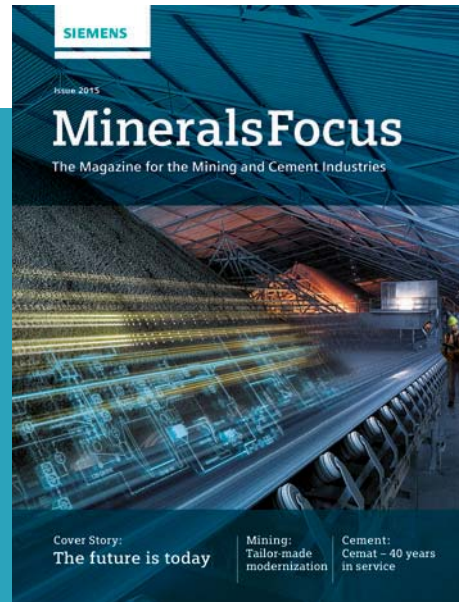
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Our magazine is also available as an ePaper. The current version can be accessed at [www.siemens.com/mineralsfocus](http://www.siemens.com/mineralsfocus). You may also order the print version at that link.



## Workshop on the Australian mining industry

At the end of March, the Australian Embassy in Berlin hosted a two-day workshop entitled "The Future of Mining in Australia." Event organizers were the German Federation of International Mining and Mineral Resources, the German-Australian Chamber of Industry & Commerce, and the Australian Trade Commission.

Siemens was represented at the workshop through presentations focusing on minerals, rail automation and rail electrification. Participants even had the opportunity to tour Siemens Mobility's eHighway test track north of Berlin where diesel hybrid trucks run on overhead electric wires.

### Share your thoughts

We want to know what you, our readers, think about MineralsFocus. In this issue you will find a survey to fill out and send back to us. Alternatively, you can fill out the survey at [www.siemens.com/mineralsfocussurvey](http://www.siemens.com/mineralsfocussurvey). We look forward to hearing from you!



Dr. Roland Grafe from Siemens Minerals gave a presentation on the company's portfolio for the mining industry.



**Publisher**  
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in accordance with  
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Mies-van-der-Rohe-Str. 8  
80807 Munich, Germany

Passavia Druckservice,  
Passau, Germany

**Publication date:**  
May 2015  
**Circulation:** 3,000

**Order No.:**  
PDLD-M10012-00-4A00  
**Dispo No.:** 21662

Photo credits: Siemens AG, unless otherwise indicated.

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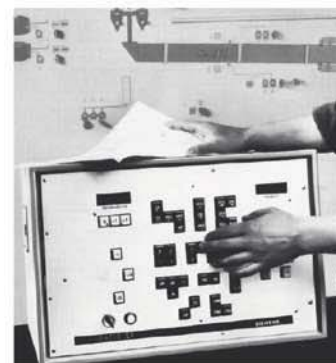
SIEMENS

# CEMAT – the 40-year success story takes the next step into the future

The leading process control system for cement production CEMAT sets a new milestone with version 8.1

Designed with the future in mind, the highly innovative distributed control system (DCS) CEMAT has been continuously setting new milestones in productivity optimization, plant availability, and energy efficiency in the cement industry for the past 40 years. Countless cement plants rely on CEMAT's top performance, for example to reduce cement production costs through resource management and productivity monitoring.

The 40-year success story is also built on Siemens' ongoing intensive research to make what's already good even better – that includes CEMAT. With CEMAT V8.1, a new milestone in efficient engineering and usability, this success will continue – thanks to innovations such as two new interlock blocks, company- or project-specific visualization adaptations, and the unique master concept for outstanding engineering efficiency.



[siemens.com/cemat](http://siemens.com/cemat)



More and more, industrial processes are going digital. While some industries are far along in the digitalization of manufacturing processes, others like the minerals sector still have some ground to cover. Technologies that have proven their value in other sectors are successfully being implemented in mines. The benefit: increased flexibility and the ability to more quickly adjust to changes in the market.