



# MineralsFocus

The Magazine for the Mining and Cement Industries

Issue 1 | 2012

**SIEMENS**

## Innovations that move mountains

Products, solutions and services for the  
mining and cement industries



The Siemens logo is positioned in the top left corner within a white rectangular box. The background of the entire advertisement is a high-angle photograph of a large-scale open-pit mine. The mine's terraced levels are visible, showing a mix of brown earth and grey rock. A winding road or conveyor system snakes through the landscape. In the distance, rugged mountains rise against a clear blue sky. The overall scene conveys a sense of industrial scale and natural resource extraction.

# SIEMENS

## The Siemens answer: Completely integrated mining solutions with superior support.

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

Commodities markets are more active than ever. But that doesn't mean that budgets are any more forgiving. Siemens solutions for the mining industry optimize productivity at every level across the process chain and throughout the project life cycle.

From excavation to transportation to preparation, we offer industry-leading technology for drives, trolley assists, power distribution, automation, water/wastewater treatment, IT and remote diagnostics. All of which boost system-wide efficiencies to save energy, ensure safety, conserve natural resources – and maximize profitability.

**Answers for industry.**

## Dear Reader,

What you have in your hands is our new customer magazine "MineralsFocus." It is a reflection of the new structure of our business area and our expanded portfolio, which now includes the cement industry. We are able to use synergies from both areas – mining and cement – and bundle them in our modular and standardized product and solution platforms Simine for mining and Sicement for the cement industry. These platforms help to ensure that investments are quickly recovered, whether for faster and more cost-effective technologies for excavation, transport and conveyance, or for more efficient process facilities and logistics centers. Even better process automation and the use of IT also create possibilities to save energy and resources, and thereby make a contribution to environmental protection.

We show how these platforms can be used with examples from Australia and Turkey. In Australia recently, mining giant BHP Billiton caused a bit of excitement with its prediction that in the next five years more than 170,000 additional jobs will be created in the country's raw materials industry, especially in the mining regions of Queensland and Western Australia. With its expertise gathered in mining projects all over the world, Siemens is ready to support companies with their challenges. In fact, Australia can be considered home turf for Siemens. And by the way, Siemens has been active Down Under for the last 140 years. Read more in our cover story starting on page 8.

Considerable growth is also expected in Turkey: by a long way the country is the biggest exporter of cement and clinker, far ahead of China and the United States. And for the last 100 years, the cement industry has been Turkey's No. 1 growth driver. In the meantime, the cement industry is growing steadily. Thanks to a range of modernizations in recent years, plants in Turkey are especially environmentally friendly. Siemens equips many facilities there with electrical components, automation technology and IT. In this issue we present several products and solutions from Siemens. We hope you enjoy the magazine.

Sincerely,

Ernst-Peter Weinmann  
Executive Vice President Minerals

Christian Sobotta  
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Business Administration Minerals

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A modernization concept for Newcrest Mining allowed for most of the existing electrical equipment to be retained, thus reducing downtimes during retrofit to a minimum.



Through innovations it has become possible to extract mineral resources under tougher and tougher conditions. For these endeavors, Siemens delivers complete solutions that meet the high demands of mining and cement companies.



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A new drive concept with asynchronous squirrel-cage motors at the Lafarge Cement plant near Pécs, Hungary, boasts minimum service and maintenance costs. And if that wasn't enough, higher efficiency is also helping improve the bottom line.





Modernization leads to higher availability and operational safety

#### Retrofit

## Concept saves time

**A modernization concept for Newcrest Mining allowed for most of the existing electrical equipment to be retained, thus reducing downtimes during retrofit to a minimum.**

Newcrest Mining of Australia operates two underground mines and one open-pit mine at its Cadia Valley Operations near Orange, New South Wales. There ore is processed to a heavily auriferous copper concentrate in a plant with crushing, grinding and flotation stages. The final product: gold. For the modernization of the site's gearless grinding mill, operators turned to Siemens Drive Technologies. Siemens engineers introduced a concept using most existing electrical equipment. As such, the implementation could be carried out during a scheduled plant shutdown along with other modernization and expansion work. Further downtimes for the gearless drive retrofit were not necessary. The two-stage grinding circuit consists of a 40 ft SAG (semi-autogenous grinding) mill with a 20 MW gearless drive designed by Siemens Drive Technologies and two series-connected 10 MW gear-driven ball mills. The SAG mill was additionally fitted with the Sinamics SL 150 cycloconverter for motor control and a Sinamics DCM power converter for controlling the excitation circuit. This was the first time the two converter types were combined in a gearless drive.

Furthermore, Siemens Drive Technologies converted the controller to a Simatic S7 and the control system to Simatic PCS 7. The modernization also saw the installation of new air gap and speed sensors as well as an access interface for remote plant diagnostics. The obsolete closed-loop control and PLC systems were replaced while keeping the motor, transformers and power section of the existing frequency converter. Siemens was responsible for the hardware and software engineering, delivery and supervision of the installation, and commissioning of the drive.

#### New aspect for existing service contract

Newcrest Mining signed a comprehensive three-year service contract with Siemens in 2010 encompassing the spare parts supply and on-call service as well as diagnostics, troubleshooting service and preventive maintenance. Thanks to the access interface for remote plant diagnostics, the service contract can be supplemented with remote diagnostics service. With eight mines in operation, Newcrest Mining by market capitalization is the world's No. 4 gold producer and the largest in Australia. The company is headquartered in Melbourne. ■

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## Environmental care

# Projects with an impact

Whether energy from waste heat, energy-saving technology or measures to lower waste, engineers at Siemens Drive Technologies are making an effort to protect the environment.

Back in 1971, Siemens established a dedicated environmental office. Since then, the company has successfully faced up to the challenge of conserving resources and protecting the environment. Initiatives and activities that extend the Siemens environmental portfolio and promote the environmental program in an exemplary manner are recognized with the Siemens Environmental Prize. At the last ceremony, which took place at the end of 2011, two prizes went to products directly related to the mining industry. The jury's decision was based on criteria including the improvement of environmental performance, the contribution to business success, and the improvement of the corporate or product image.

In the category "Environmentally compatible products and solutions," the first prize went to the team of Dieter Schletterer in recognition of a pilot project for converting waste heat into electricity at Südbayerisches Rohrdorfer-Zement. Rohrdorfer Zement had commissioned Siemens to convert the excess waste heat generated at its cement plant into electrical

energy. On average, cement plants release about 40 percent of their waste heat into the atmosphere – heat that goes unused. The Siemens pilot system, which sets new industry standards, is also being supported by the German Federal Environment Ministry.

In the same category, Joy Mazumdar and her team received special mention for the development of a current collector system for mining trucks. Thanks to the technology, vehicle consumption can be reduced by up to 80 percent.

These and the other projects honored at the Siemens Environmental Award are proof of Siemens' commitment to the planet's ecosystem. And in more cases than not, they have a positive impact on the bottom line. ■

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Joy Mazumdar and his team received special mention in the "Environmentally compatible products and solutions" category



First prize in the "Environmentally compatible products and solutions" category went to the team of Dieter Schletterer



■ Portfolio for the mining and cement industries

# Innovations that move mountains

Innovations have always helped drive the mining and cement industries. First with the intelligent use of water and steam power – and later most notably with the application of electrical energy – it has become possible to extract mineral resources under tougher and tougher conditions. In the meantime, automation and IT as well as intelligent drives help to economically extract and process mineral resources. For these endeavors, Siemens delivers comprehensive answers that meet the high demands of mining and cement companies.





**F**iercer competition and fluctuating market prices hold ever-greater challenges for mining and cement companies in regard to profitability. Productivity therefore becomes the element that leads to a company's success or to its demise. As a result, excavation and processing technology must be continuously modernized. Larger equipment, for example, helps to excavate raw materials more quickly and cost-effectively. More efficient processing methods guarantee successful yield even with low ore concentrations. And more intelligent process automation and better networking among individual components create numerous possibilities to save energy and to protect resources and the environment.

But progress alone is of no use when technical applications are not aligned with one another: the weakest link in the system has an impact on the entire supply chain – from removal with dragline, shovel and bucket excavators; to transport of the material with conveyors or trucks to processing facilities, mills, floating vessels, filters and roasting plants; all the way to handling at shipment points with loading and reloading equipment. Downtimes can lead to serious production losses. For this reason, dependability is the guiding principle in Siemens' product families Simine and Sicement with their modular and standardized products and applications for the entire lifecycle of mining and cement and processing facilities.

The modularly constructed components are especially aligned to fulfill requirements and include the complete drive-train and automation and IT concept from a single source for plant construction and modernization as well as for the expansion of existing plants. Tried-and-tested industrial standards such as Simatic S7, Simatic PCS 7 and Simatic IT are at the core of the modular application platforms. They are combined with one another in such a way that they handle all special requirements and exploit new potential to lower operational costs, improve profitability, ensure higher plant availability and reduce project risks as well as start-up losses.

### The Simine product family

In the Simine product family, Siemens links its automation and drive systems as well as the associated energy supply for a universal and consistent application. The portfolio can be employed with primary tasks, such as excavation, transport and processing

of raw materials, as well as for secondary processes such as energy supply and water treatment all the way up to facility service and maintenance. For example, the Siemens application Simine Winder for shaft hoisting is designed for high performance and security so that the shaft does not become a plant's bottleneck. Drive applications on the basis of Sinamics converters – in connection with a standardized control and safety system that fulfills requirements set down in mining law – ensure high plant availability at maximum utilization rates.

In the product groups Simine Drag and Simine TR, Siemens drives and converters also ensure higher speeds and more productivity for mining trucks and bucket wheel excavators. Simine Con offers complete electrical applications for the throughput-optimized and energy-efficient operation of conveyors. Variable speed Sinamics converters increase the lifetimes of mechanical components, such as belt fasteners, drum coatings and mechanical brakes for curved belts and conveyors that operate downhill. Special conveyor controls ensure that the conveyor is always optimally loaded and uses less energy – up to 20 percent less according to the load.

### Siemens as a trendsetter for gearless drives

Crushing raw mineral materials is a very energy intensive process. Therefore, the challenge facing processing plants is to reduce emissions as well as energy and water use while maintaining optimal material throughput at low operational costs. Gearless drives have been especially developed for use in cement and ore mills as well as for conveyors. Compared with conventional drives, these drives require less space and weigh less. Because a range of mechanical and electrical components are omitted, dependability increases and the entire system becomes 3–4 percent more efficient. Drive maintenance alone can amount to up to 5 percent of the original investment volume. Back in 1970, Siemens first installed gearless drives at Südbayerisches Portland-Zementwerk.

Gearless drives are included in the product groups Simine Mill, Simine Pump and Simine Con. The gearless drive boasts the lowest energy consumption of a variable-speed drive. For years, the drives have been synonymous with nearly wear-free operation in 30 concentrator plants worldwide. The drives' patented control concept allows pre-

**Dependability is the guiding principle in our product families Simine and Sicement.**





Simine can be employed for primary tasks such as excavation, transport and processing; for secondary processes like energy and water; and for service and maintenance

cise adjustment for every requirement – all the way to operation with the lowest speeds possible during revisions. IT-based monitoring also lowers downtimes and thus makes a contribution to maximizing performance. Siemens customers report over 99 percent availability. The situation is similar with cyclone pump drives: the gearless drive system Simine Pump is up to 30 percent more energy efficient than conventional models and offers considerably higher pump availability.

A brief overview of the newest applications of gearless drives from Siemens speaks for the soundness of the investments:

- For ThyssenKrupp Robins, based in Colorado, Siemens installed the drive system for a conveyor at the Peruvian mine Antapaccay. The final customer is Xstrata Copper. In the framework of this project, gearless conveyor drives are being employed for the first time outside Germany.

- Peruvian mining concern Compañía Minera Antamina S.A. installed Siemens gearless drive systems for an SAG (semi-autogenous grinding) ore mill with a rating of 20.1 MW and a ball mill with a 11.2 MW rating.
- Minera Lumina Copper Chile S.A. commissioned Siemens to install three gearless mill drives Simine Mill GD as well as all electrical equipment. The systems are being used in the development of the new Caserones copper mine in Chile's Atacama region, where starting in 2013 copper and molybdenum will be excavated and processed.
- Siemens is also taking over maintenance of the gearless drive systems for two ore mills for the Mexican company Minera Peñasquito S.A. de C.V., based in Zacatecas. The contract also includes support for the associated energy technology.
- Minera Los Pelambres commissioned Siemens with the delivery of gearless mill drives for an SAG mill and for a ball mill.





- » More powerful drives and larger mills make it economical to excavate material with low ore concentrations. Therefore, Siemens offers mining companies a gearless drive system for SAG mills with a diameter of 42 ft. Compared with 38 ft mills that are in widespread use today, this larger mill almost doubles throughput.

### Sicement product family

Cement and concrete consumption serve as indications of a country's economic development. Worldwide there more than 2,000 cement works – hardly a region is left out – that deliver to construction sites everywhere. Siemens supports the world's cement works with its product family Sicement, which is aligned to meet the cement industry's requirements. Sicement is based on products, systems and services that have already been used successfully in a large number of cement works. Integrating these applications into a complete package opens up additional possibilities for optimizing plant operation. Sicement takes the entire lifecycle of a plant into account and helps cement plant operators save money and increase competitiveness.

With Sicement Drives, for example, electrical and mechanical systems can be combined with the various technical requirements of tube mills, kilns, conveyor belts and fine grinding. Thanks to standardization, they can be fully integrated in a uniform

energy supply network and control system, despite different power spectrums.

Cemat, the integrated process control system, plays a key role throughout all corporate levels of the cement industry and in all phases of cement production. It includes all necessary components and helps reduce cement production costs through resource management and productivity monitoring – from raw materials to finished products. The high-performance distributed control system was developed in close cooperation with the cement industry so that it meets all cement production requirements. More than 30 years of operation in harsh cement production environments serve as proof of the system's effectiveness.

A brief overview of the latest applications of Cemat from Siemens speaks for the soundness of the investments:

- The Holcim Chekka plant in Lebanon supplies cement to both local markets and the Middle East region. During a planned kiln maintenance shut-down period of just 12 days, Siemens replaced the original communication and control systems with the new distributed control system Cemat, based on version 7 of Simatic PCS 7. The upgraded system not only fulfills Holcim's objectives in terms of reliability, speed and usability, it also minimizes plant downtime, increases productivity, optimizes energy use and provides real-time process management data.





**Innovation is needed to reduce the huge amount of energy required and to optimize production. In both cases, Siemens is the right partner.**

- For the Lafarge cement plant in Hungary, Siemens supplied the electrical power equipment, including medium-voltage switchgear, motor control centers and distribution transformers. The process control is handled by the Simatic PCS 7 process control system and Cemat sector software. An integrated management information system provides the operating company with an up-to-date overview of the production status as well as archiving functions. Furthermore, a new drive concept from the Sicement Drive product family was used for the mill drives. The vertical mills were equipped with brushless induction motors and soft starters. The new plant in Pecs, Hungary, now has a capacity of 2,500 tons of cement a day.

To achieve the facility-wide networking and transparency required by the cement industry, Siemens developed the management information system Sicement IT MIS. The results are efficient plant operation, a high degree of reliability and investment security.

Sicement IT MCO processes and analyses production and company data, and with the use of algorithms helps to lower energy consumption, optimize the operation of cement mills and improve clinker quality. With their comprehensive knowledge, specific sector know-how and their global network, Siemens experts on location can optimize their customer's operational processes through the interplay of drive, control, regulation and security technology.

Just as electronic media have changed everyday life, so too have they made an impact on the construction material industry. Interconnectedness and transparency are their biggest contributions – from quarries all the way to cement silos. Innovation is needed to reduce the huge amount of energy required and to optimize production. In both cases, Siemens is the right partner. ■

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■ Siemens' mining activities in Australia and New Zealand

# Equipment for mills Down Under

Since 1928 Siemens has been providing reliable, innovative and tailored mining solutions for its extensive, global installed base. As such, Australia is no exception. In fact, Siemens equipment and solutions can be found in most mines throughout the country – from Tom Price to Gladstone, from Gove to Queenstown.





**F**or Siemens, 2012 marks 140 years of operation in Australia. The first contract in 1872 involved the supply of porcelain insulators for an overland telegraph line between Adelaide and Darwin. Since this time Siemens Ltd. Australia and New Zealand has been offering a wide range of solutions and services in the two countries, where today Siemens Industry, Energy and Healthcare Sectors occupy leading positions. In fiscal 2011 (October 1, 2010 – September 30, 2011), Siemens' sales to customers in Australia and New Zealand amounted to €1.16 billion and new orders totaled €1.21 billion. About 2,100 employees work for Siemens Australia and New Zealand. A partner of the region's mining companies, Siemens delivers technology solutions that help solve some of the industry's greatest challenges: harsh climates, remote sites, safety, environmental protection, rising energy costs and water scarcity. Equipment must therefore be able to withstand heat and cold as well as dust, water and shock. Stiff competition and fluctuating raw material costs require mine operators to keep an even closer eye on expenditures. Productivity has become a criterion for business success or loss of an investment. This calls

for further technology improvements and an increase in mining capabilities: larger equipment, more efficient recovery and preparation methods, and more intelligent automation.

### **An integrated approach**

As one of the active global players in the mining industry, Siemens has developed a comprehensive answer to these challenges: integrated solutions that encompass the entire supply chain, from extraction to

## **Siemens offers complete functional packages to manage some or all steps of the mining process chain.**

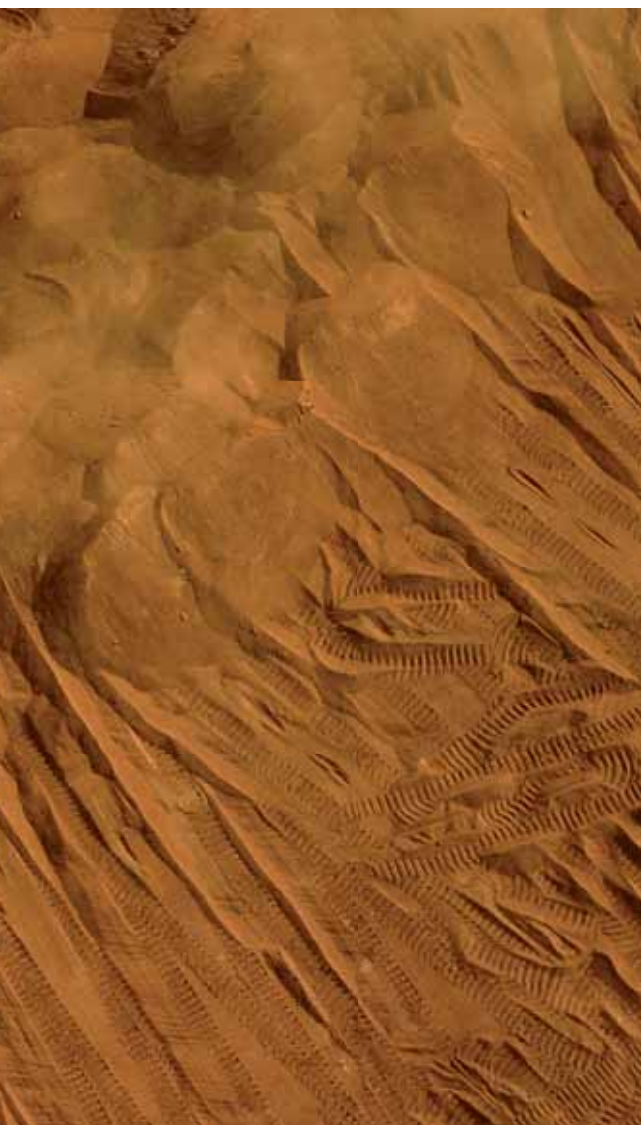
transportation and beneficiation of raw materials. Together, these solutions support future technology migration and expansion of mine operations. This integrated approach is backed by the expertise of thousands of Siemens employees who continually work on advanced solutions for diverse industries, including mining and metals. For example, Siemens has been involved in some of Australia's largest mining projects including CITIC Pacific Mining's Sino Iron project. This world-class magnetite iron ore operation is the first of its kind to include large-scale downstream processing. Siemens will supply the equipment for the 450 MW power station, including eight 47 MW gas turbines, gearless mill drives and associated switchyard equipment. The contract was won largely on the basis of the industry-leading efficiency of these machines.

Siemens offers complete functional packages to manage some or all steps of the mining process chain. The current broad mining solution portfolio includes but isn't limited to:

- Drives for shovels, trucks and conveyors, and gearless mill drives for ore grinding
- Automation and control
- Manufacturing execution systems (MES)
- Water, including potable water, process water and wastewater treatment solutions
- Low- and medium-voltage power systems and lifecycle services for the range of Siemens equipment and systems

### **Simine mobile mining solutions**

The Simine mobile mining solutions are end-to-end electrical engineering and technological solutions for all stages of discontinuous mining operations. The package combines electrical engineering and technological solutions to ensure greater performance, security and efficiency of all equipment for draglines (Simine Drag), shovels (Simine SH), trucks (Simine TR) and conveyor belts (Simine Con). »



► In 1999, Siemens developed an AC electric drive system for larger open-pit mining haul trucks manufactured by Hitachi, Liebherr, Komatsu and Belaz. This AC electric drive system replaces less efficient and more maintenance-intensive DC drive systems. In Australia, these drive systems and traction motors are used in Hitachi EH4500, Hitachi EH5000 and Liebherr T282 haul trucks. Siemens also provides local repair services for rotating

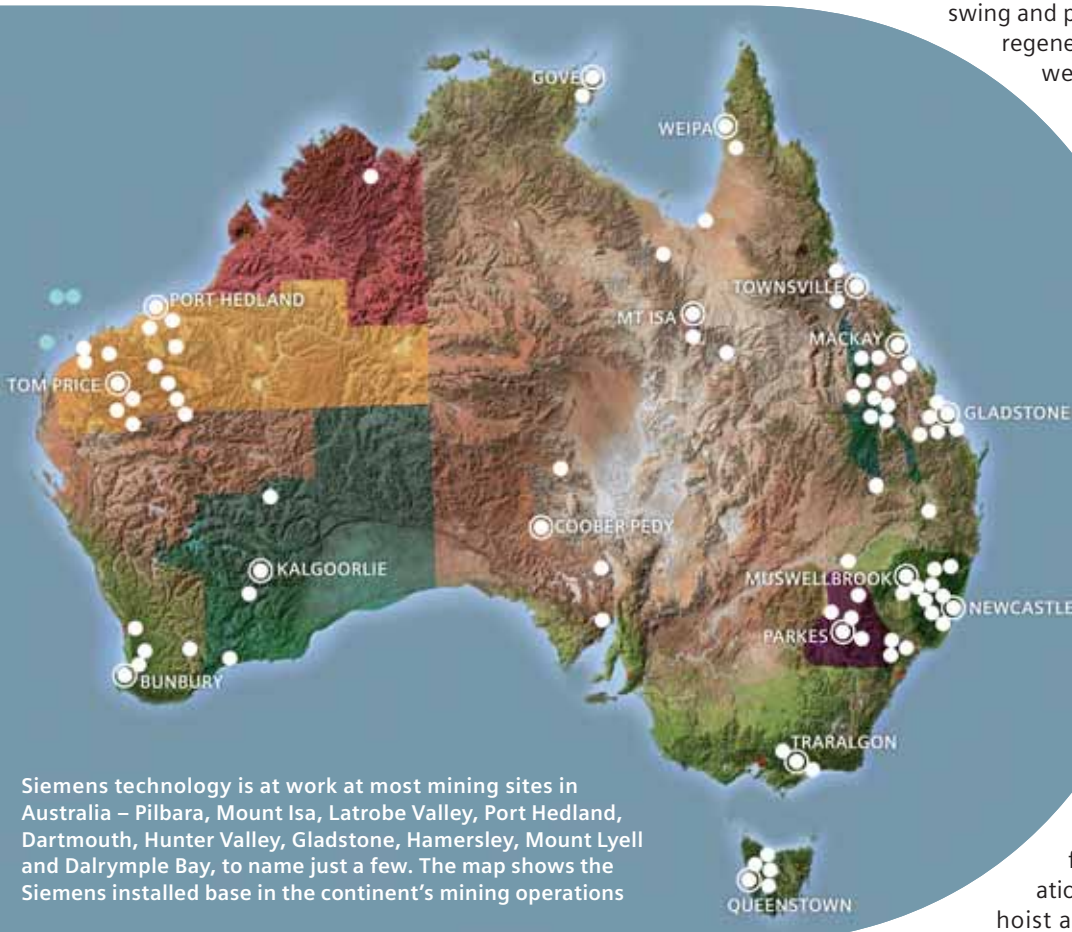
Using AC drives means that less power is needed to perform the same task. The latest dragline drive system has an active front end that feeds power back into the grid in regeneration mode. CAT Bucyrus also has delivered an 8750 AC dragline for the major expansion of open-pit mining within the Capcoal surface operations complex in the Bowen Basin, Queensland. The first walk was in December 2008. Siemens AC drive systems are used to hoist, drag, swing and propel this dragline. Each drive is regenerative. Siemens' local personnel were part of the installation and commissioning team to achieve the first walk. Immediately after handover, Siemens personnel stayed on site to help with initial problems. In the meantime, a Siemens engineer is stationed at Lake Lindsay to support the total scope of supply. Furthermore, Siemens provides AC helper drives for CAT Bucyrus draglines.

The dragline at the Wesfarmers Curragh mine, also in Queensland's Bowen Basin, is a CAT Bucyrus Marion DC dragline powered by motor generator sets. Though CAT Bucyrus and Siemens have worked together for some time on new drive systems, this was the first CAT Bucyrus-Siemens cooperation on an AC helper drive retrofit for hoist and drag on a DC dragline. These

drives are regenerative (active front end) to reduce power usage. The retrofit included AC motors, a Siemens Flender gearbox for the drag function, and solutions for integration software challenges. As with the Lake Lindsay dragline, Siemens Australia was part of the installation and commissioning team, and now provides ongoing support.

### Simine continuous mining solutions

Simine Cont for continuous mining combines the individual steps in open-pit mining into an overall system for maximum performance. The solutions include mechanics, power supply, automation and drive systems for bucket chain and bucket wheel excavators, all integrated into a comprehensive system. Siemens guarantees safe and economical operation and optimized output for conveyors (Simine Con), mine winders (Simine Winder) and grinding mills (Simine Mill).



equipment as well as on-site product support and training for the truck OEM electrical personnel. An optional trolley assist provides higher on-grade speed out of the pit, which equates to either faster cycle times for increased production or fewer trucks for the same production levels. It also creates opportunities to secure long-term competitive electricity contracts from the grid rather than relying on fluctuating diesel prices.

Furthermore, thanks to the several-year relationship with CAT Bucyrus, Siemens provides AC drive systems for the hoist, drag, swing and walking motions. And to increase power and productivity, Siemens offers AC retrofits for DC drive systems. The Anglo Coal Lake Lindsay dragline will be the first in Australia and the second in the world to use AC motors for all motions.



Integrated diagnostic tools offers efficient maintenance and reduced costs throughout the mine's entire lifecycle. Simine Winder offers the highest safety and improved throughput with its innovative solutions for drive engineering, performance-optimizing drive-level closed-loop controls, and safety-oriented automation engineering. The technological closed-loop controls ensure the harmonious customization of travel behavior to the specific requirements of the shaft system. The double-skip friction winder at the Northparkes copper and gold mine was commissioned in 1996. A Siemens drive system and motor are at the core of the winder, which is still running on the original control system. After 15 years of service in today's rapidly changing technological environment, it continues to demonstrate the dependable design and quality of Siemens' drive solutions.

Siemens leads the world in gearless technology – its drive system is synonymous with years of virtually wear-free operation. The concept eliminates all mechanical parts between motor and mill. Fed with variable frequency from a fuseless short-circuit-proof cycloconverter, Simine Mill features the highest operating efficiency of any variable speed drive (VSD) available – leading to reduced mill downtimes and substantial energy savings. The main benefits include controlled acceleration, deceleration and stopping of the mill; precise and fast positioning in inching and creeping mode; and no downtimes due to lack of girth gear/pinion maintenance. Siemens gearless drive motors power AG, SAG and ball mills located in Queensland, New South Wales, South Australia and Western Australia for preeminent mining companies like Newcrest, BHP Billiton, Barrick and MMG. At Newcrest's Cadia mine, the Siemens gearless mill drive (GMD) was the first 40 ft mill in the world. At the other end of the scale, a 24 ft Siemens gearless drive motor – first commissioned in 1979 at Sydvaranger mine in Kirkeness, Norway – was recommissioned at Century mine in Queensland in 2008. It has now been running for more than 30 years after its initial commissioning. The latest GMDs use Sinamics as the control system, which is now the same platform from Siemens for the smallest VSD all the way up to the largest drive. Siemens GMDs also showcase Simatic S7 and PCS 7 control software and visualization for mining. A highlight in 2011 was the sales release of 42 ft gearless drives.

At a KCGM mine site in Western Australia, the Siemens 12 MW (2 x 6 MW motors) SAG mill drive system has delivered reliable ore grinding from initial commissioning in 1995 to modernization of the control and visualization systems in 2006. KCGM relies on the local and global expertise of Siemens to keep its business running; Siemens' comprehensive lifecycle support service contract provides business certainty. The twin pinion mill drive application uses the same



control system technology as the gearless drive technology, providing variable speed to optimize the grinding process and throughput. The system is equipped with Simatic PCS 7 control software and visualization for mining, and it measures the torque of each motor to ensure that both motors share the load equally.

### Complete end-to-end handling

Siemens offers also mechanical and electrical drive solutions for middle and high torque ranges from the electrical supply of the driven load. The highly diversified Siemens product portfolio encompasses couplings, industrial gear units, electric motors, converters and controllers. At the heart of the automation control components, six core system features of Totally Integrated Automation (TIA) are exhibited: engineering, communication, diagnostics, safety, security and robustness. Standardized, flexible and scalable to meet process requirements, Simatic has diagnostics inherently built in to keep the critical operations for maximum availability and productivity and less downtime. The Siemens condition monitoring systems provide a constant view of all machines and the entire system. This facilitates predictive maintenance and allows maintenance operations to be planned and implemented in due time. Thanks to its universal competence, Siemens is able to offer complete materials handling solutions from a single source, which reduces risks associated with commissioning, installation and operation. Recent customers to recognize these benefits include Rio Tinto (Clermont and Kestrel sites) and BMA (Hay Point expansion). ■

Packages from Siemens can help manage individual aspects of the mining process chain all the way up to an entire operation. Key aspects include drives for shovels, trucks and conveyors as well as gearless mill drives for ore grinding

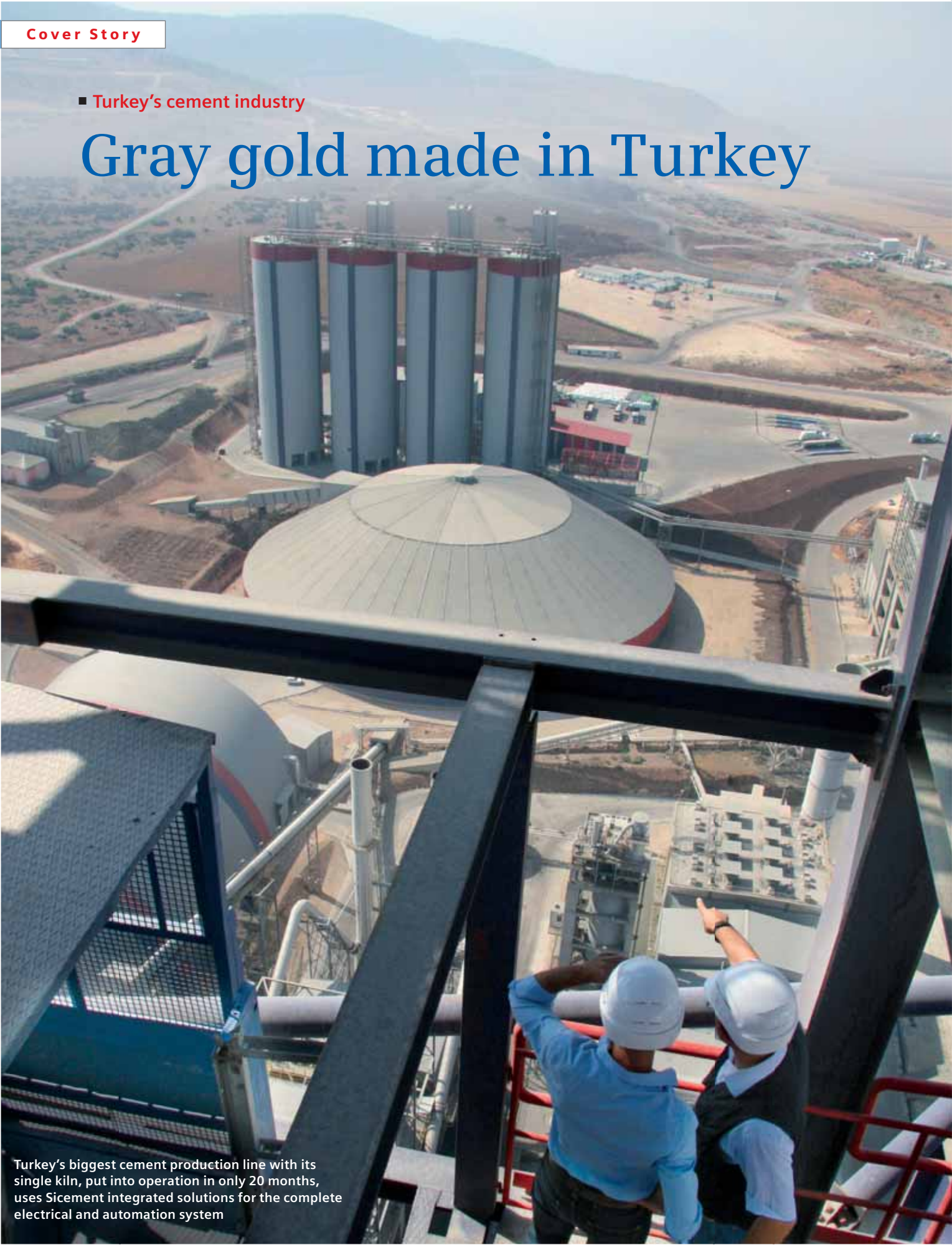
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■ Turkey's cement industry

# Gray gold made in Turkey



Turkey's biggest cement production line with its single kiln, put into operation in only 20 months, uses Sicement integrated solutions for the complete electrical and automation system

The demand for cement shows no signs of letting up. Worldwide approximately 2,000 cement plants produce around 3.3 billion tons of the “gray gold.” China has a particularly strong appetite for cement, which consumes more than half of the world’s production, followed by India, the United States and Turkey. For quite some time, the Siemens office in Turkey has specialized in electrical equipment for cement plants.

For the last one hundred years, Turkey’s cement industry has been the country’s No. 1 growth driver. In 1911 the production capacity of Turkey’s cement industry was 20,000 tons; today it is more than 66 million tons. This puts Turkey at the top of the list for cement production in Europe. Worldwide, the country is the biggest exporter of cement and clinker, with a volume of 19 million tons leaving its ports annually. The cement industry is poised for long-term growth. And thanks to modernization in recent years, it has become especially environmentally friendly.

#### Market leader for cement plant equipment

Siemens started its activities in Turkey at the beginning of the 19th century when leaders in the Ottoman Empire made the decision to construct a telegraph system in the country. After project completion, Siemens & Halske opened an office in Istanbul. In the years following, projects concentrated on a telephone network and widespread electrification. In the 1950s focus turned to industrial plants in line with Turkey’s economic program to decrease dependency on foreign imports by opening regional factories to produce goods like sugar, cement, iron and steel. In 1958 Siemens provided the Ankara Cement Plant with electrical systems. Further projects followed primarily for low- and medium-voltage switchgears as well as for conventional control systems. In 1986 the first plants, such as the Çimentaş Cement Factory, were outfitted with new automation on the basis of Simatic.

Siemens Turkey boasts a high level of expert knowledge for turnkey projects, expansions, conversions and modernization. Today Siemens Turkey is the market leader for electrical and automation technology for cement works. The range of services covers the delivery and installation of electrical equipment and integrated solutions including design, planning, engineering, project management, manufacturing, installation, testing and commissioning. As always, Siemens realizes projects with as many local resources and facilities as possible. Customers value Siemens’ excellent solution competence, which has led to many projects involving Cemat, the process control system designed especially for the cement industry. Cemat is based on the process control system Simatic PCS 7, and as such

it offers all the capability characteristics and functions of the system. Users have many analyses, trend reports and optimization suggestions at their disposal, which they can use to, for example, more flexibly and efficiently design product process and to lower emissions without impacting production. The standardized solutions in the industry-specific platform Sicement that target energy distribution, automation and measuring systems have proven their benefit for fast commissioning.

## Siemens Turkey boasts a high level of expert knowledge for turnkey projects, expansions, conversions and modernization.

#### Various projects

The following is a brief listing of recent cement projects Siemens Turkey has realized at home and abroad:

##### AS Cement in Bucak-Burdur

AS Cement produces 4.3 million tons of clinker yearly in two rotary kilns and 6.5 million tons of cement in five cement plants. In 2005 Siemens equipped Line 1 in Bucak-Burdur, which has a daily capacity of 3,000 tons, with power distribution and automation systems. Three years later a second line with a production capacity of 8,500 tons of clinker per day was commissioned. AS Cement in Bucak-Burdur is Europe’s largest production facility. Altogether, the projects have increased AS Cement’s daily capacity to 12,000 tons. The site’s output is destined for export to Europe and Russia. For both plants, Siemens delivered turnkey projects that included electrical equipment such as 6.3 kV medium-voltage and 0.4 kV low-voltage switchgear, automation systems, information management systems and diverse process instrumentation. Construction for the second line was done within 17 months; the Siemens share of work was completed in just 10 months.

##### Çimko Cement in Kahramanmaraş

In 2007 Çimko Cement built a new plant in Kahramanmaraş, in southeast Turkey. The plant »





Çimko Kahramanmaraş cement plant, Turkey: Siemens Turkey delivered and installed all electrical and automation components on turnkey basis within 20 months

- » is home to the largest cement production line in Turkey with a daily capacity of 7,500 tons. The line consists of a rotary kiln, a warehouse and a silo transporter, all of which were constructed within 20 months – a very short period of time for a project of this magnitude. The newest technological improvements, machines and low-energy equipment were built into the plant, which is especially environmentally friendly. Dust emission levels, for example, are far below EU norms. The plant includes limestone, additive and coal crushers, and three raw mills, kiln coolers, roll presses and cement mills as well as packing facilities. Siemens delivered and installed the complete electrical and automation equipment and took care of services like testing and commissioning.

#### **Nuh Cement in Hereke, Kocaeli**

Nuh Cement Plant is located in the Marmara region. With a market share of 6 percent, the plant is one of the region's largest cement production sites. In 2005, with the goal to double clinker production capacity, a third clinker line with a capacity of 6,000 tons per day

was constructed. Siemens' scope of delivery was motor and drive systems, motor control centers (MCC), two 30 MVA medium-voltage transformers, medium-voltage switchgear, as well as emergency power equipment including measuring and monitoring systems and the associated process instrumentation on the basis of the Cemat process control system. Siemens was also responsible for the basic and detailed engineering as well as for the interface design of the complete electrical and automation technology.

#### **Kelete Cement Factory in Turkmenistan**

As a result of Turkmenistan's fast industrialization, in the past years demand for cement has risen enormously. Every year some 1.5 million tons of cement are imported into the country. GAP Insaat, a construction company that belongs to Turkish-owned Calik Holding, was commissioned by Turkmenistan's government to construct a new turnkey cement plant in Kelete with a daily production capacity of 3,000 tons. The goal: high-quality cement that, compared



with imported cement, is cheaper to produce over the long term. Siemens Turkey was responsible for the high-, medium- and low-voltage switchgear, lighting, emergency and auxiliary power distribution, compensation units, and process automation and process instrumentation. Construction, tests and commissioning were also in the scope of delivery. All power distribution system panels were manufactured in Siemens' Istanbul facilities, which included meticulous engineering and continuous inspection phases. The entire production line is controlled with the help of programmable logic controllers type Simatic S7-400, which are integrated in the Cemat system. A management information system was set up for the long-term archiving of process variables and to store data for other external data-processing systems. Design, planning, overall project engineering, tests and commissioning were completed in 2005 by the competent Siemens Turkey teams.

#### Cement factories in Jebel and Koytendag, Turkmenistan

On behalf of the Turkish company Polimeks Insaat, Siemens Turkey was awarded with contracts to provide the electrical equipment and automation system for two new cement lines with a capacity of 3,000 tons per day in Jebel and Koytendag, Turkmenistan. Once again, Siemens Turkey took



The newest technological improvements were built into the plant, which is especially environmentally friendly

**The new cement production line is setting clear performance benchmarks in terms of efficiency, productivity and environmental protection.**



The plant has also been designed for minimum dust emissions



Proactive maintenance concentrates on high plant availability, reliability and cost efficiency



Siemens took care of services like testing and commissioning

over the complete electrical equipment and automation, including the Cemat process control system based on Simatic PCS 7. The electrical equipment consists of 110 kV high-voltage and 6.3 kV medium-voltage switchgear, transformers, 0.4 kV main distribution, panels, motor control center, compensation systems, control cables and lighting as well as medium- and low-voltage motors and drives. These projects have been processed on a turnkey basis using local resources for project management, engineering, manufacturing, electrical installation and commissioning.

#### KÇS Cement Factory in Maraş

In 2012 Siemens Turkey signed the contract for the second line of KÇS Cement factory in Kahramanmaraş, Turkey, for 4,500 tons per day of clinker. The contract was signed in February and Siemens' scope includes electrical and automation systems including motors and drives. The project is scheduled for completion in May 2013. ■

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# Solution platforms

The Siemens portfolio can be applied for primary tasks such as excavation, transport and processing of raw materials as well as for secondary processes like energy supply and water treatment all the way to plant service and maintenance.

Dependability is the guiding principle in Siemens' product families Simine and Sicement with their modular and standardized products and solutions for the entire lifecycle of mining and processing facilities: from removal with dragline, shovel and bucket excavators; to transport of the material with conveyors or trucks to processing facilities, mills, floating vessels, filters and roasting plants; all the way to handling at shipment points with loading and reloading equipment.

The Siemens Drive Technologies Division supplies all-around solutions that meet customers' exacting requirements. These solutions allow the customers to take targeted action to reduce energy consumption while enhancing product quality.

The Siemens solution Simine Winder for shaft hoisting is designed for high performance and security so that the shaft does not become a plant's bottleneck. In the product groups Simine Drag and Simine TR, Siemens drives and con-

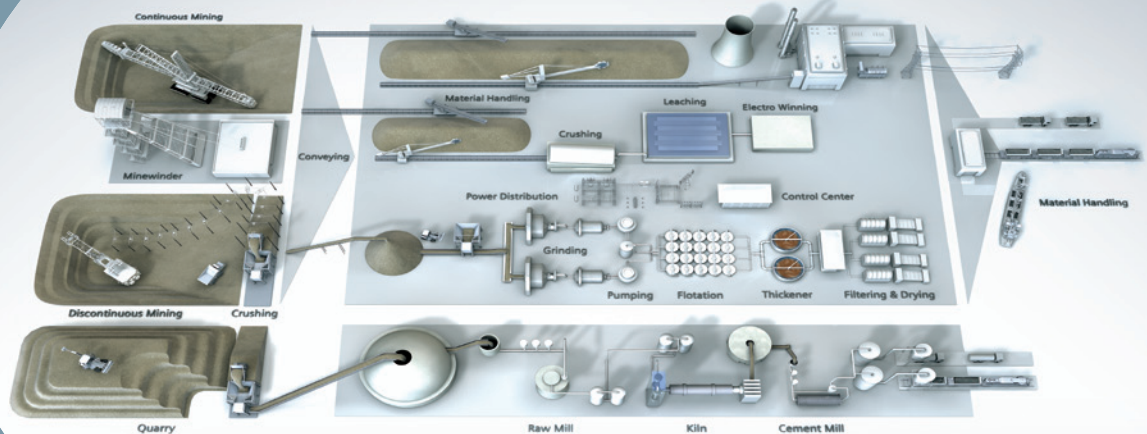
verters also ensure higher speeds and more productivity for mining trucks and bucket wheel excavators. Simine Con offers complete electrical solutions for the throughput-optimized and energy-efficient operation of conveyors. Gearless drives are included in the product groups Simine Mill and Simine Pump. The Simine Mill GD gearless drive boasts the lowest energy consumption of a variable-speed drive.

The Sicement product family has been especially adapted to meet the requirements of the cement industry, and it combines project management with coordinated system products for the functionality of cement works. At 45 percent, the milling process accounts for a major share of a cement works' overall energy needs. Sicement Drives can be used, for example, to combine electrical and mechanical systems with a variety of technical requirements and specifications. Sicement IT gives customers the opportunity to process and analyze both production and company data.



# at a glance

The product and solution platforms Simine for mining and Sicement for the cement industry contain modular, sector-specific solutions for energy production and distribution, drive technology, process control and instrumentation, data management, plant infrastructure and maintenance. All products, systems and services are coordinated with one another, and their success has been proven time and again in field applications. Using these modules, Siemens puts together the optimal overall concept for every plant operator, whether for new construction, expansion or modernization, or for operation in existing underground mines and open-pit mines, processing facilities, cement works and filling plants. The result is excellent facility operation with a high degree of dependability and investment security as well as increased productivity, flexibility and sustainability over the entire lifecycle.



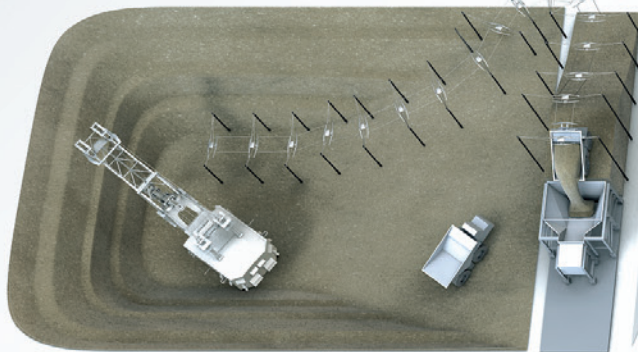
Continuous Mining



Minewinder



Discontinuous Mining



Crushing



Quarry

Conveying



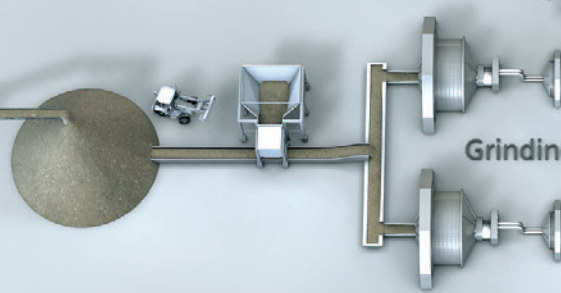
Material Handling



Crus



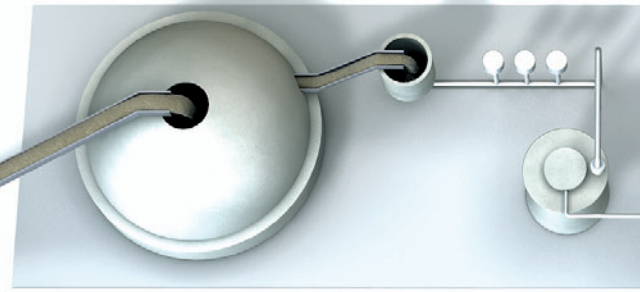
Power Distribution



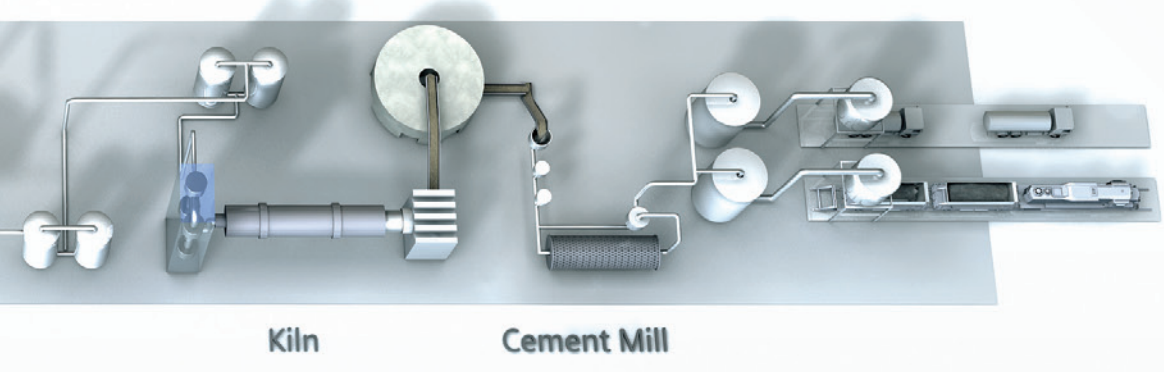
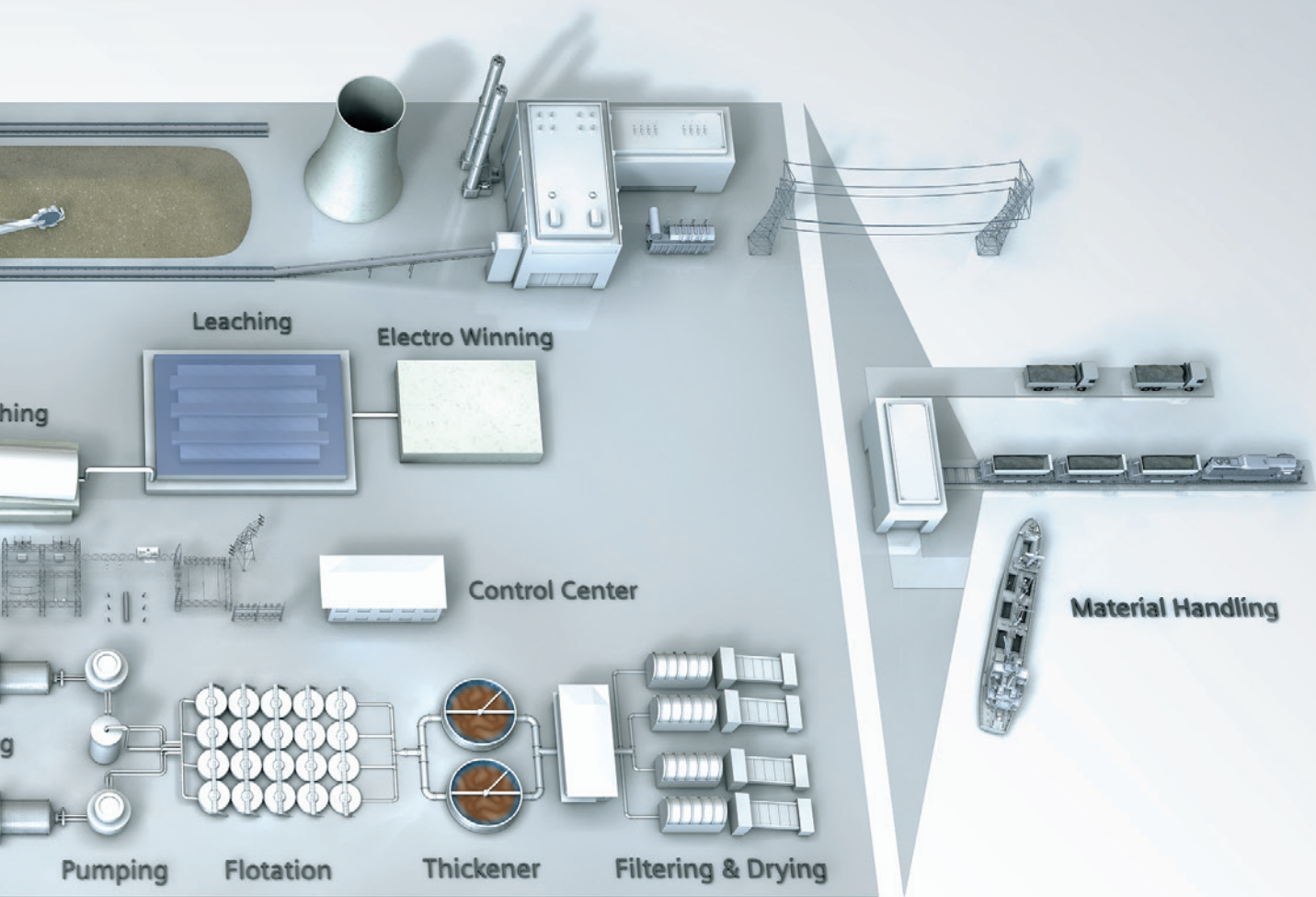
Grinding



Raw Mill









■ Gearless conveyor drives in mining operations

## Workhorses for today's mines

In many mining zones, ore grades are declining. New mines are being developed in more remote areas, pits are getting deeper and underground mines are becoming larger. This means that more and more material must be transported over long distances, which poses new challenges for material handling. Thanks to technologies that are part of today's larger drive systems, the increasing volumes from mines can be processed more efficiently while meeting high demands for availability.





In Xstrata Copper's Antaccapay mine, the air-cooled cyclo-converter Simatic SL 150 is used

The first conveyor system to operate with AC gearless drives was installed in 1986 by Siemens and Thyssen-Krupp in the Prosper-Haniel mine from Deutsche Steinkohle AG



For many years ThyssenKrupp and Siemens have partnered to help build some of the most impressive conveyor systems in the mining industry. One of the greatest success stories is the Los Pelambres downhill conveyor in Chile, which remains the highest tension conveyor in the world. The conveyor transports 10,000 tons of copper ore per hour over a distance of 12.7 km, which drops from 3,200 m to 1,600 m above sea level.

Moreover, the conveyor generates up to 17 MW of electrical energy. Continuing their successful teamwork, ThyssenKrupp and Siemens are delivering a gearless drive system for the overland conveyor of Xstrata Copper's new Antapaccay mine in Peru. The conveyor system will transport ore over a distance of some 6.5 km from the mine to the processing plant on a 1.37 m wide belt traveling at 6.2 m/s. When the belt conveyor system is commissioned later this year, it will be capable of transporting approximately 5,260 tons of material per hour. The Siemens drive system comprises two low-speed synchronous motors – each with a total power of 3,800 kW – and the associated Sinamics SL150 cycloconverters. Furthermore, Siemens is supplying the motor cooling system, converter transformers and complete e-house for the drive station. The closed-loop control, which is part of the delivery, improves load sharing between the two motors. Gearless drives

for conveyors can be a good alternative for power requirements above 3 MW. The capital expenditures are similar or even less compared with a conventional geared solution. Furthermore, the gearless drive application for the conveyor includes the benefits of high availability and robustness, and reduced operating costs, maintenance costs and noise levels. In the coming years, a number of orders are expected from South America for large overland conveyors with down- and uphill sections. For the mining companies it will be more and more important in the future to reduce energy consumption and increase reliability; therefore, gearless drive applications will be used more frequently for this kind of conveyor.

### A mining favorite

Gearless drive technology is nothing new to the mining business. For many years mining companies have been installing gearless drives for mine hoists, excavators, draglines, pumps and mill applications. While the technology is similar, the circumstances with conveyors differ. Similar to mills, conveyors require a lot of torque during start-up, especially in uphill applications. Gearless drives are helping operators to increase efficiency with highest reliability and low maintenance. Already in 1985 ThyssenKrupp and Siemens installed a gearless direct-drive belt conveyor with cycloconverter-fed synchronous motors. Engineers at RAG Deutsche Steinkohle were strongly impressed by converter technology and decided to apply it to the underground Prosper-Haniel coal mine in Germany. More than a quarter century later, the belt drives are still in operation – to the complete ►►



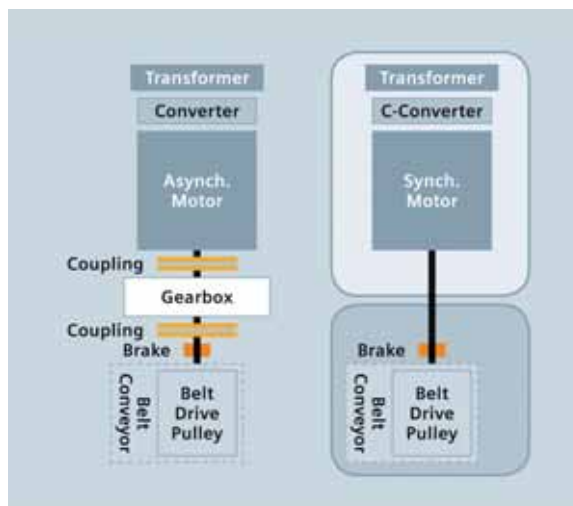
### Benefits of a gearless drive solution compared with gear-reducer technology:

- ▶ Higher plant availability by eliminating electrical components, couplings, bearings, and gearboxes – therefore minimizing the risk of downtime
- ▶ Up to 4 percent higher energy efficiency achieved with gearless direct-drive technology
- ▶ Longer conveyors with fewer and smaller drive stations and reduced excavations in underground applications
- ▶ Higher power at the pulley, free from traditional gearbox limitations
- ▶ Reduced maintenance needs by lowering the potential for mechanical breakdowns and the use of robust components
- ▶ Fewer spare parts resulting in fewer inventories and less capital investment
- ▶ Lower noise levels achieved by removing the reducer, the loudest component of all

▶ satisfaction of the customer. In fact, the conveyor system boasts availability of more than 99 percent. According to RAG management:

- There have been no significant interruptions or failures attributable to motors and converters
- Maintenance costs are significantly less than for belt drives with gearboxes
- Estimated savings of 10 percent on electrical energy are achieved annually compared with fixed-speed applications

Long conveyors with high throughput and steep height differences require a significant amount of power. When the demand for power exceeds 3 MW per pulley, gearless drives for the conveyor are the right solution. Drive configurations for large conveyors with gearboxes soon reach their physical limits. For example, a conveyor system with a drive power demand of 20,000 kW would require eight traditional drives, each equipped with 2,500 kW motors. Such a solution carries the disadvantage of reduced overall availability associated with a large number of mechanical components. A gearless drive solution for the conveyor could be realized with only three low-speed drive motors.



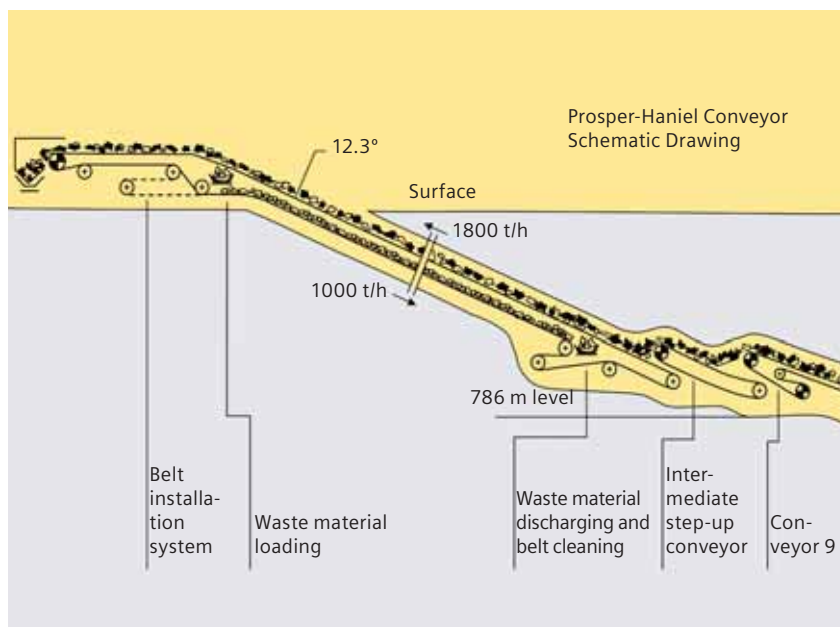
Conventional drive system (left) and speed-controlled gearless drive (right). By reducing mechanical parts, maintenance costs can be brought down significantly. Savings are estimated up to 5 percent of the initial investment costs on an annual basis

Gearless drive conveyor system from Siemens and ThyssenKrupp





This system overcomes the restrictions attributed to gear reducers, and its gearless construction is simple, robust and easy to maintain. Cycloconverter technology with high overload capability has proven its strong reliability over several decades. For operation in weak electrical networks the voltage-source converter Sinamics SM150 with IGCT technology can be used too. For downhill operation the drives are able to work in regenerative mode and to support the mine operation with additional electrical energy. Conveyor belt suppliers are also able to manufacture stronger belts (ST-10,000) that can withstand more powerful stresses resulting from higher drive power. Fewer high-performance drives can do the job of many conventional drives: This formula makes longer conveyors possible. And with fewer components, the drive stations have smaller footprints. In underground applications, the number of expensive cavities is minimized. ■



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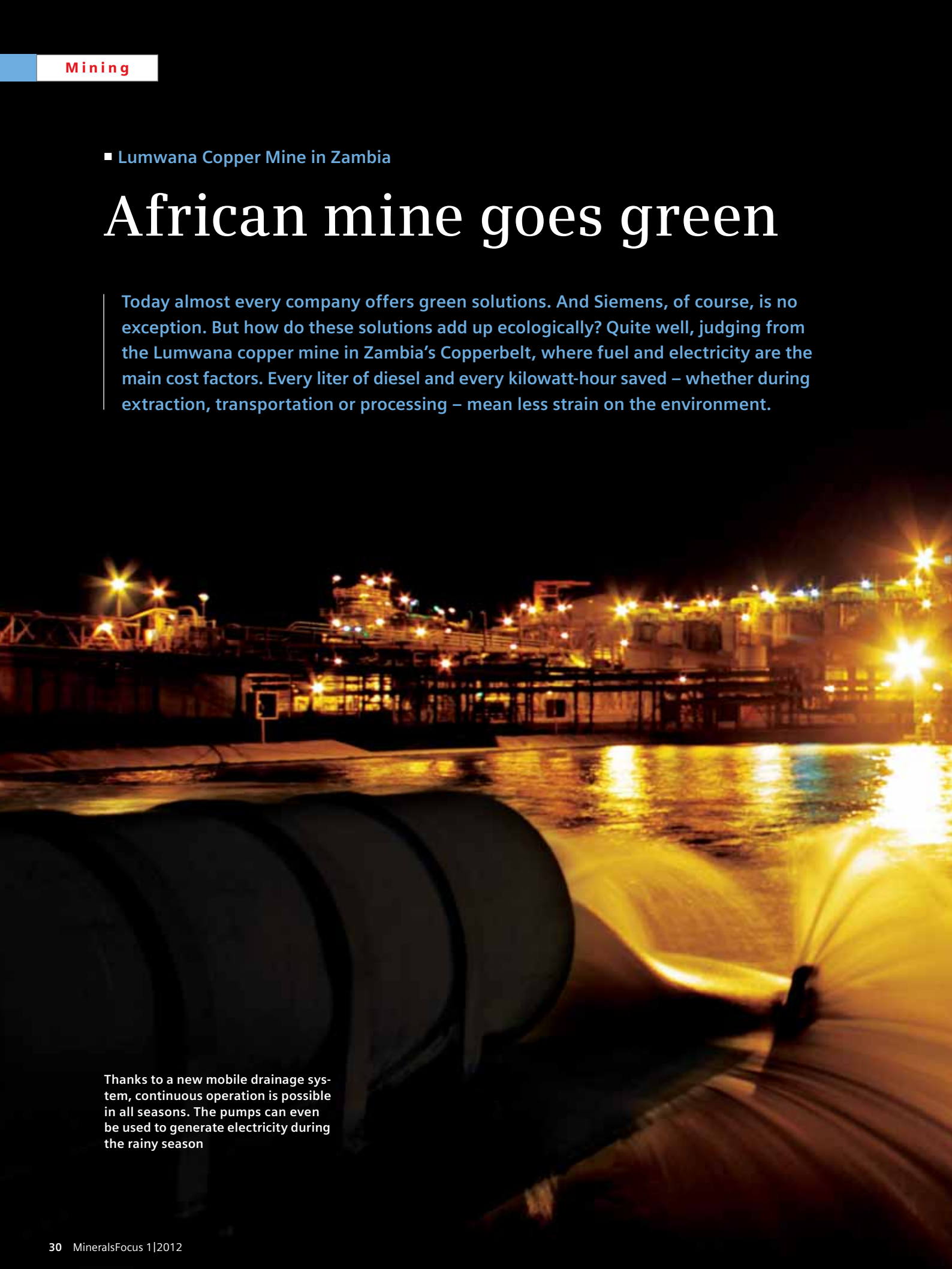
Gearless drive for a coal conveyor for the Prosper-Haniel underground mine in Germany. The conveyors transport in both directions, with two gearless motors located on the surface



■ Lumwana Copper Mine in Zambia

# African mine goes green

Today almost every company offers green solutions. And Siemens, of course, is no exception. But how do these solutions add up ecologically? Quite well, judging from the Lumwana copper mine in Zambia's Copperbelt, where fuel and electricity are the main cost factors. Every liter of diesel and every kilowatt-hour saved – whether during extraction, transportation or processing – mean less strain on the environment.

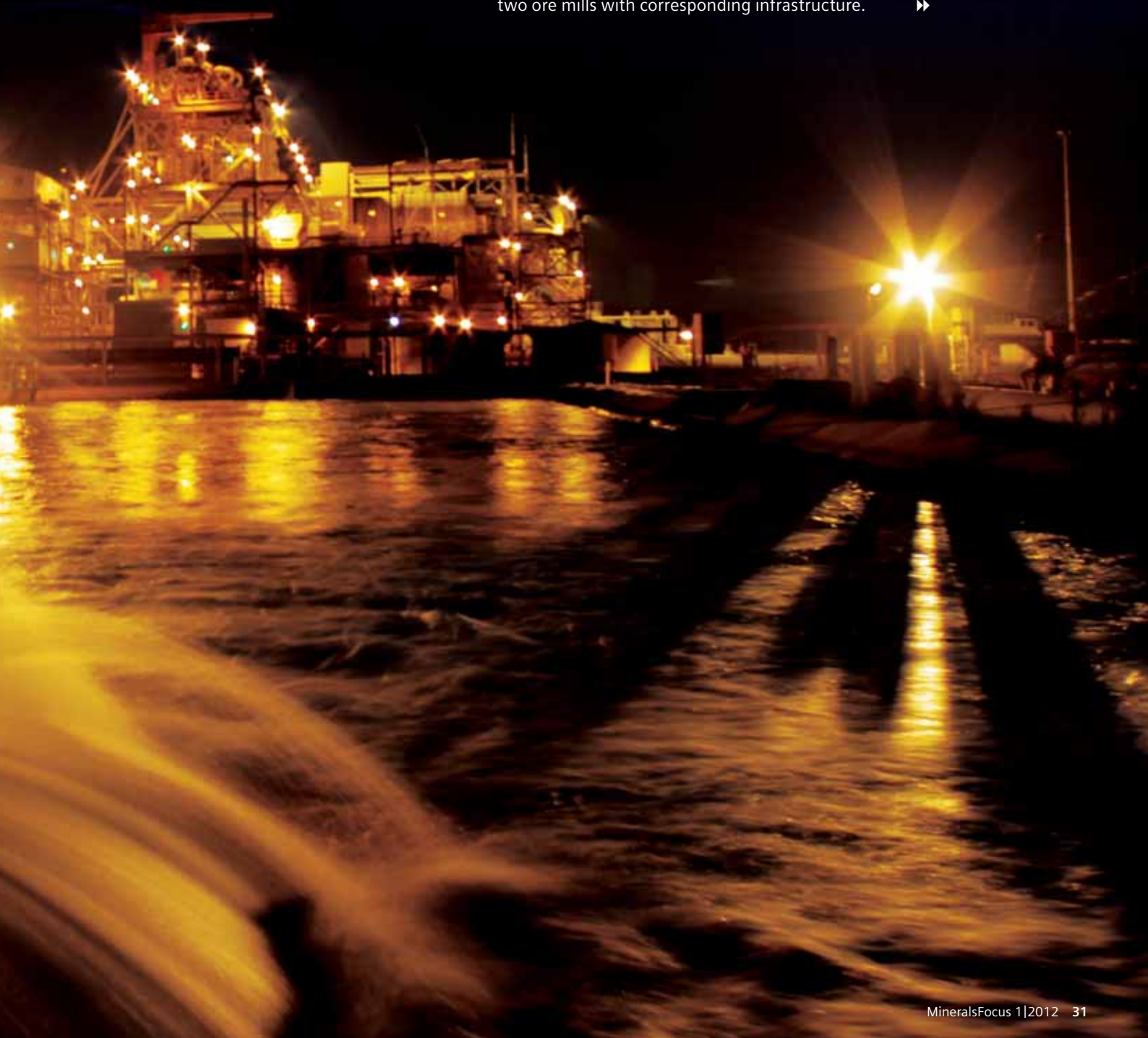


Thanks to a new mobile drainage system, continuous operation is possible in all seasons. The pumps can even be used to generate electricity during the rainy season



**T**he Copperbelt in Zambia is one of the world's largest copper and cobalt reserves. In the 1960s with a yearly production of up to 750,000 tons, Zambia counted among the world's largest producers. When the copper price fell at the end of the 1990s, it became too expensive to excavate profitably due to the outdated infrastructure. As a result, many mines were closed. Only when copper prices rose again a short time later did the Copperbelt experience a renaissance.

The Lumwana mine, some 220 km northwest of the copper belt, was the target of \$800 million in investments by Australian-Canadian Equinox Minerals Limited. With a yearly production of almost 170,000 tons of copper, the mine is among the top 10 worldwide and one of Africa's largest copper mines. Within the coming 20 years, Equinox plans on excavating over 400 million tons of ore from the new mine. In addition, the extensive gold, cobalt and uranium deposits will also be tapped. Infrastructure will be constructed for the mine, which will be among the country's most modern. Around 1,000 people will work at the mine's operations. In 2007 Siemens received a contract to deliver equipment for 27 open-pit mining trucks and two ore mills with corresponding infrastructure. ►►



## ► Solutions for lower fuel consumption

Trucks in open-pit mines normally use copious amounts of diesel and burden the environment with exhaust gas. Using conventional technology and methods, engineers calculated that the copper mine would consume 3.5 million liters of diesel every month, which amounts to 8 percent of Zambia's total fuel use. Furthermore, the mine requires 100 MW of electricity, which is provided by energy company Zesco. To operate mining trucks more cost-effectively, Siemens developed the Simine TR diesel-electric drive concept. The AC motor is optimally controlled via power electronics, which strongly reduce conduction and switching losses. With their strong electrical brake performance, the drives also increase safety and lower wear on the mechanical brakes. At the same time, they offer a high starting torque. In a comparison with a diesel motor, an analysis showed that the environmental compatibility increased by 11.6 percent with the diesel-electric drive concept. Furthermore, operating costs fell by 7 percent: instead of 400 liters of fuel per hour, with the new drive only 360 liters per hour are consumed.

Additionally, gradients in the mine were equipped with cantenaries through which the trucks receive electricity, much like trains. As such, the trucks save fuel and are considerably faster on ramps. "Compared with diesel-electric operation, the fuel rate with the trolley system is even more efficient with a hourly usage of just 45 liters," says Zane Berry, Mine Superintendent at Lumwana Mining. The trucks can also travel faster: instead of the previous 8 km/h they reach top speeds of up to 24 km/h. "Overall the trolley system increases turnaround rates by more than 85 percent and efficiency by 10 percent. In connection with considerably higher availability, this enabled us to reduce the size of our truck fleet, which in turn helped lower operating costs."

## Gentle operation with gearless drives

Aside from the drives for the trucks, Siemens also delivered and installed drives for two ore mills. The first ball mill has a diameter of 38 ft (11.6 m) and is equipped with a drive output of 18 MW; the second has a 26 ft (8 m) diameter and an output of 16 MW. The gearless ring motor drive system Simine Mill GD can variably control the speed of the drives with the help of transvector regulation. Mill operations can therefore be precisely adjusted to the changing characteristics of the feed material, for example the composition, size or hardness. Because there are no gears, expenditures for maintenance and repairs are low. Gentle stopping and starting as well as the nonexistent mechanics between the drive and the mill reduce wear considerably. The drives operate more energy efficiently with a 5 percent higher efficiency factor than with conventional drive systems.

Furthermore, the Frozen Charge Shaker function is employed in the ore mills. This enables controlled removal of charge stuck in the grinding tube, and manual cleaning no longer has to be carried out. Altogether, these measures help reduce overall operating costs. Siemens delivered not only the complete electrical equipment for the open-pit trucks and ore mills but also the electrical infrastructure including all key substations, the complete plant automation and the communication system in the open-pit mine. At the heart of the system is a network of fiber-optic



Cantenaries on the mine's gradients, similar to those used with rail travel, provide the trucks with electricity. The result: lower fuel consumption and higher speeds on ramps





Siemens installed the drives in two ore mills: one with a diameter of 38 ft (11.6 m) and equipped with a drive output of 18 MW; the other with a 26 ft (8 m) diameter and an output of 16 MW

The Simine TR diesel-electric drive concept helps mining trucks operate more cost-effectively



cables, also referred to as the OTN (Open Transport Network). Along with process and automation data, the fiber-optic cables transport data such as seismic activity, gas and fire alarms, pressure states and video signals. Thanks to these fiber-optic cables, the entire mining operation (vehicles, crushers, pumps and conveyor belts) can be tracked in real time via monitors and controlled from the communications center. Finally, a new mobile drainage system was set up that allows continuous operation in all seasons. The system's pumps can also be used to generate energy, for

example during the rainy season. In this case, water at higher elevations is drained off through the pumps, whose reverse motion creates electricity that is used in other parts of the mine. As a whole, the Lumwana Mine is today a very efficient open-pit operation that uses energy sensibly for a high output. ■

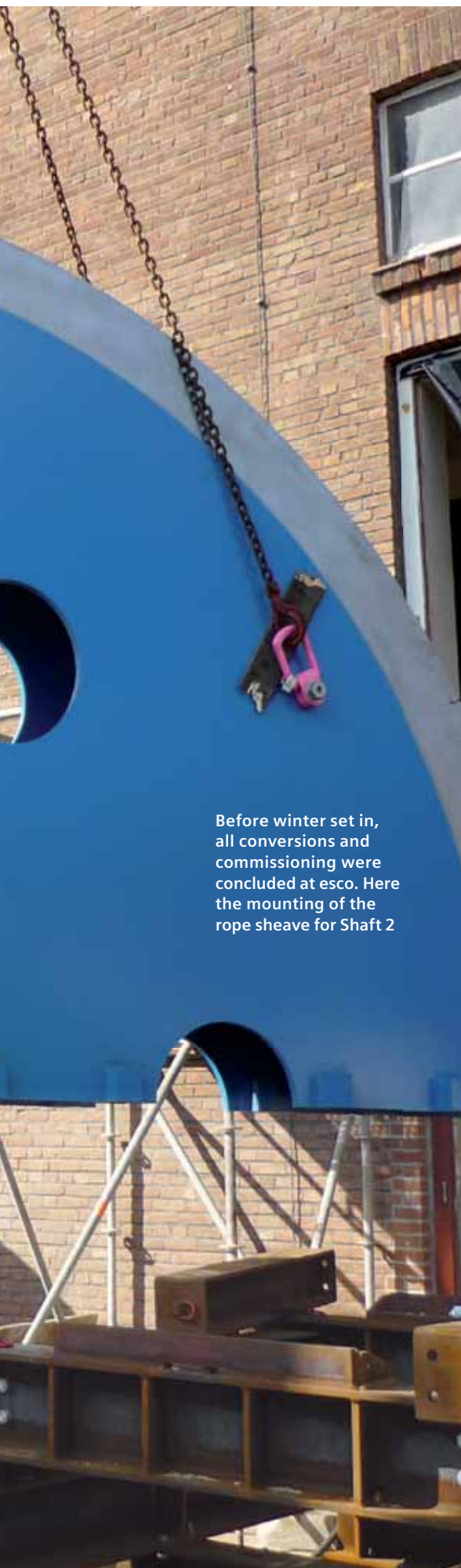
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■ Siemens modernizes two shaft-hoisting systems for esco

# Robust, safe and reliable breaking





Before winter set in, all conversions and commissioning were concluded at esco. Here the mounting of the rope sheave for Shaft 2

A newly developed multi-channel, deceleration-controlled safety brake has been installed at the Borth salt mine. At the heart of the solution is the Cobra 01 hydraulic safety brake, developed by Siemens and mining equipment specialist Olko Maschinentechnik. Cobra 01, the most advanced system in terms of safety, was recently approved by mining authorities for use in mines.

Rock salt has been extracted from a depth of 700–1,000 m at the Borth salt mine in the Lower Rhine salt pan since 1924. This layer of salt is around 200 m thick and extends to the Dutch town of Winterswijk around 50 km away. Siemens was hired by esco (European Salt Company GmbH & Co. KG) to modernize the hoisting system in Shaft 2. This shaft is primarily used for transporting people and materials. The existing system, built in 1942, was technically outdated and therefore required a large amount of maintenance and repair work. Furthermore, it was difficult to obtain replacement parts. The motor and bearing had already been refurbished ten years ago. Last year Siemens was commissioned with completely renewing all other components of the hoisting system, including the drive pulley, brake system, power unit, control stand for the hoisting system operator, and the shaft signaling system. This is the first time anywhere in the world that the Cobra 01 hydraulic safety brake, developed by Siemens and the mining equipment specialist Olko Maschinentechnik, is being put to use.

#### Newly developed Cobra 01 safety brake

The brake system consists of braking force generators and hydraulic and electric brake control. So-called discharge brakes are used as braking force generators. The braking force is produced by springs. A hydraulic mechanism releases the brakes (the spring assemblies are tensed). Particular importance is attached to the brake controls of the hoisting system. They must serve as a service brake, a holding brake and a safety brake. The most crucial function is the safety brake, which activates in case of a failure such as a power shortage, over-speed or a major disturbance in the shaft area. Normally the safety brakes have a constant, fixed safety-braking force and two different constant safety-braking forces that depend on depth, direction of rota- ►►

- tion and carrying load. In normal hoisting operation, the disadvantage of these brakes is that they only serve as holding brakes and hardly experience any wear. In case of a failure, the frictional force may not prove sufficient, which is why the brake pads require precautionary maintenance work every three years. For this reason, engineers are increasingly turning to controlled safety brakes, as the overload varies considerably while the load is being hoisted. In this case, the control ensures that the hoisting system comes to a halt at a predefined rate of deceleration, regardless of the load conditions. An electronic control adds the required brake power via independent valve units.

Now a newly developed deceleration-controlled safety brake has been installed at the Borth salt mine. The term “controlled brake” means a brake system that, in case of a failure, brings the winder to a halt at a constant, predefined rate of deceleration, regardless of the load, the direction of rotation, the wearing of

## Cobra 01 enables constantly controlled delay of the winding machine thanks to an electronic control system.

the brake lining and fluctuations in the friction coefficient. This multi-channel deceleration-controlled brake system is currently the most advanced system in terms of safety. It was recently approved for use by mining authorities. It has three control circuits, with the total number of required braking force generators divided between these circuits. Operational availability is increased by always using an additional reserve channel. This completely eliminates the need for an additional spare unit, thus minimizing costs and space requirements. Modern accumulator technology has also been used, which minimizes the required pump capacity and allows for a considerably more compact construction. The use of fast and very reliable Simatic S7-300 controls allows the system’s “intelligence” to be shifted into the electronic control, thus reducing the number of valve groups required. Because brake power is applied in a controlled manner, the hoisting equipment experiences less wear and the rope is prevented from slipping. All safety-relevant components are doubled. Siemens also provides a new drive pulley and a new brake with brake stands.

### New speed control

Another key element of the modernization was the tried-and-tested speed control (winder technological controller, WTC). All control and safety functions are integrated into this WTC. The two-channel safety-

oriented SPS that controls the drives was specially developed for controlling hoisting equipment. It is able to quickly process control commands for hoisting equipment and shaft signals while simultaneously carrying out the required safety tasks. With the help of standardized Simatic S7 components, it monitors and controls the hoisting system speeds and the positioning of the mine cages. In doing so, the controller reduces and optimizes the transportation times.

The WTC was designed with control components that are integrated directly into the two Simatic S7-400 devices. In order to meet the special safety requirements, the entire control level has a redundant design. All functions relevant to safety in case of a fault are combined in safety circuits: safety circuit,



Since 1924, rock salt has been excavated from depths of 700–1,000 m at the Borth salt mine in the Lower Rhine salt pan

service brake circuit and blocking circuit. This allows the electric drive to be instantly stopped and prevented from starting up again when the safety brake is triggered. The WTC has been approved in accordance with the strict German Technical Requirements for Shaft and Inclined Haulage Equipment (TAS) and the Mining Regulations (BVOS).



## Proven electronics

The system design, which prioritizes maximum safety, is based on extremely reliable, robust drive systems that have proven themselves for decades in direct current technology. They quickly and precisely adjust the motor speed to the current operating requirements – such as the number of people using the shaft, the weight of their equipment and current safety requirements – and instantly deliver the full torque when they start up. For this reason, the existing direct current motor was connected to a new current converter from the Simoreg DC-Master range. As an essential part of Totally Integrated Automation (TIA), Simoreg DC-Master converters can be seamlessly incorporated into higher-level automation environments. This is a particular advantage in the context of the safety concept mentioned above.



The visualization system Simatic WinCC flexible is incorporated into the automation and drive systems. It is used to operate and monitor the entire shaft hoisting system. All operating data of the drive and all other system components are visible on the monitor. This allows for instant, targeted intervention by the hoisting system operator.

As well as supplying and installing the customized system made up of Simoreg DC-Master current con-

verters, WTC and Simatic S7-400 controllers and the Simatic WinCC flexible visualization system, Siemens was responsible for the hardware and software engineering, assembly supervision and commissioning of the shaft hoisting system as well as instruction and training of operating personnel. Siemens also supplied current transformers and a correction and filter circuit system to reduce reactive power and harmonic oscillations, expanded the low-voltage system, modernized the cooling system, and provided a new shaft signaling and monitoring system.

## A modern hoisting system for Shaft 1

Thanks to the new hoisting system on Shaft 2, esco can transport a carrying load of 8.5 tons at a hoisting speed of 12 m per second. The modernization of the system began in spring 2010. The existing hoisting system continued to operate at this stage. In November – in time for the start of winter, which is the busiest operating period – the winder passed inspection by an expert from DMT and was approved by the mining authority of the Arnsberg district government, thus allowing it to begin permanent operation. Project manager Matthias Lückert of esco was very happy with the professional manner in which this ambitious project was conducted, and he is already looking forward to working together again with Siemens on the upcoming project to modernize the hoisting system in Shaft 1. This will also involve modernizing all essential components, apart from the 4.3. MW direct current motor, and installing the new deceleration-controlled safety brake. Shaft 1 has a conveying distance of 753 m and the new hoisting

## All retrofitting and commissioning work at Shaft 1 were completed within an idle period of just 19 days.

speed will be 18 m/s with a carrying load of approximately 20 tons. Because this is a tower shaft hoisting system, planning logistics present a great challenge. All large and bulky components have to be positioned using a crane. Each crane lift up to the 54 m high platform takes around 15 minutes. All retrofitting and commissioning work had to be completed within an idle period of just 19 days so that esco could begin operating again at the start of September 2011 for the following winter season. ■

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## ■ Simine Automation and MES

# Seamless integration increases productivity

Over the past decades, mining companies have focused their investments on program logic controllers (PLCs) and SCADA systems on the plant floor to improve processes and remain competitive. On the business side, investments in enterprise resource planning (ERP) systems have made commercial processes better. Simine Automation and MES links these two levels and thus becomes the key element for discovering optimization potential and closing the information gap between the production floor and ERP. This is the basis for enabling greater productivity improvements and financial benefits in a shorter period of time.

With an increasing level of automation and with the deployment of sensors and mechatronics, mines and preparation plants produce better and more reliable data. The range includes the status of a single motor or intelligent field instrument on the shop floor up to a wide variety of process parameters and mathematical models for beneficiation and materials handling. This information ensures the transparency of complex processes, helps to control production on the basis of new targets, and allows faster and easier maintenance in order to reduce unplanned downtimes. Developments in information technology contribute significantly to optimizing workflows and to saving energy and reducing costs.

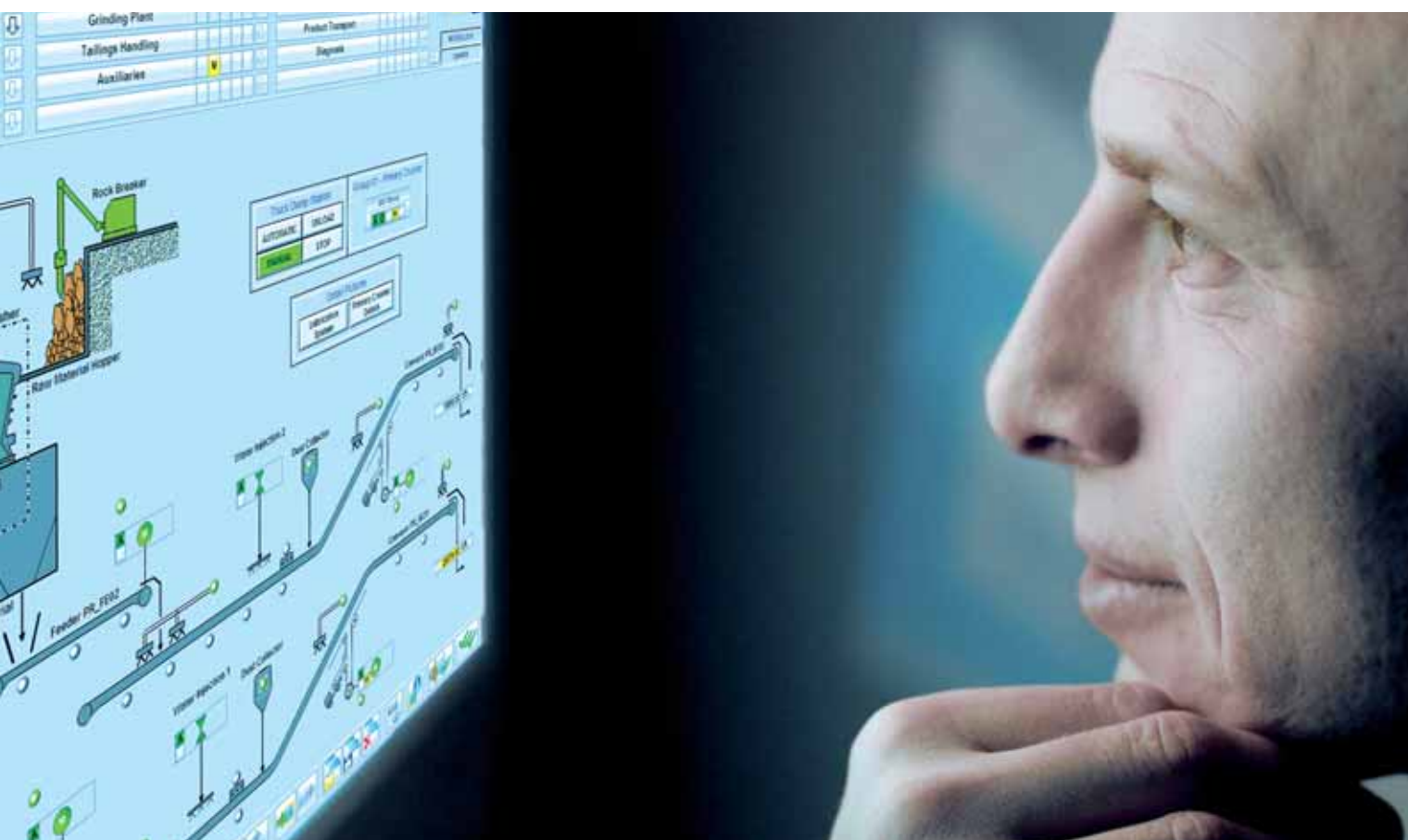
At the business level, investments are focused on enterprise resource planning (ERP) systems that aim to better manage business logistics. However, this tends to result in an information gap between the business processes run by ERP and the production processes and equipment used in automation and

operations. To close the gap and make production more efficient, Siemens developed Simine Automation and MES, a seamlessly integrated solution for the mining industry.

## Out-of-the-box solution for mining

Simine Automation and MES covers the whole automation and IT landscape, from sensors to business decisions and from excavation to shipping. It merges the technological processes with the business processes in combining the high potential of ERP systems in the area of financial management, procurement, human resource management, marketing and sales with the different production processes typically found in the mining industry. The Siemens system increases the transparency of the manufacturing process along the complete supply chain and is the centralized information platform for operators as well as for management. The company-wide supply chain capacity planning system includes integrated maintenance planning, which can be provided along with plant- and area-specific





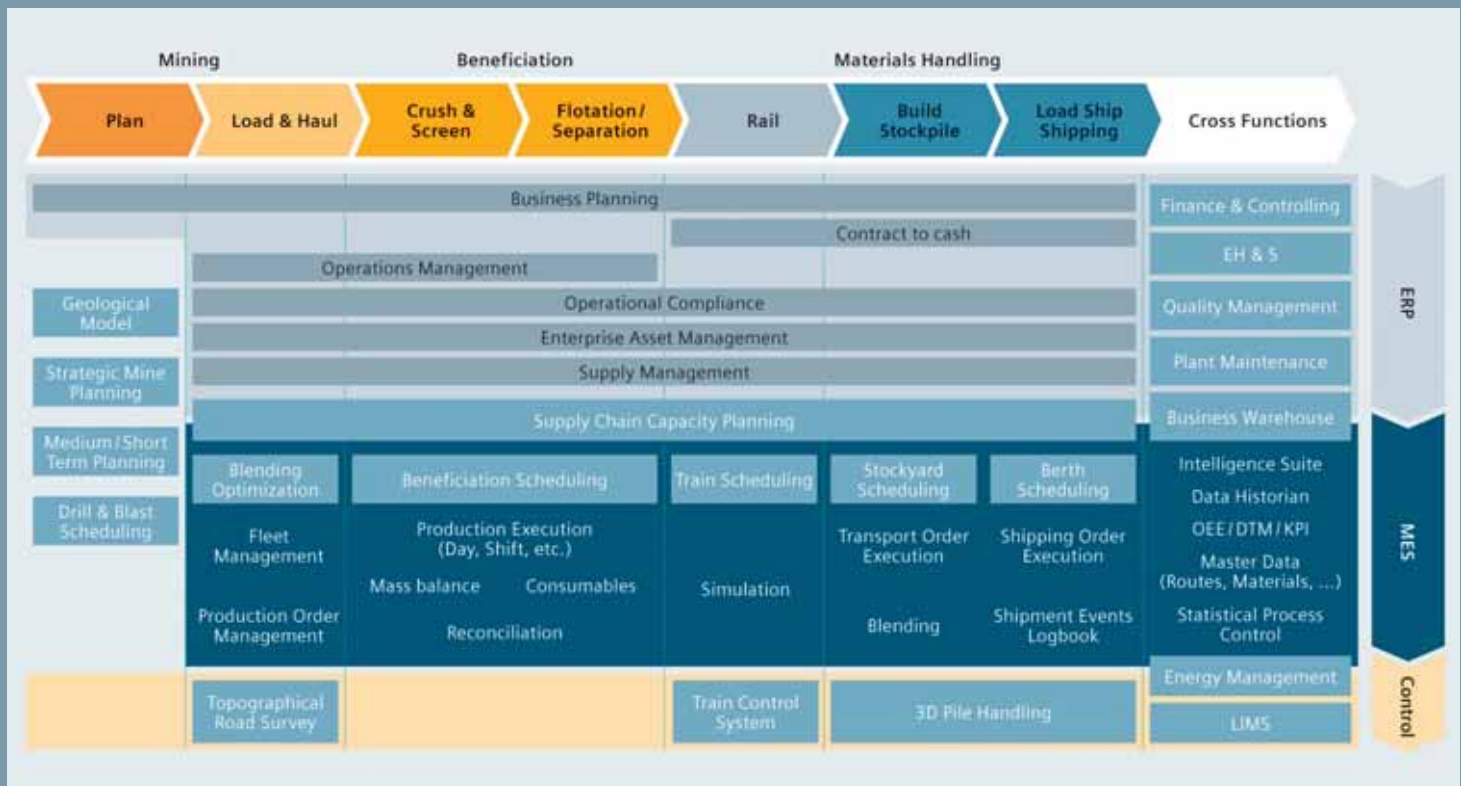
Simine Automation and MES is the solution to increase profit

## **Simine Automation and MES links the plant floor with the business side and closes the information gap.**

real-time scheduling for berths, stockyards, railways, beneficiation and mines with blending optimization. This results in maximized throughput, higher product quality, and fulfillment and delivery performance – and reduces the supply-chain costs associated with bringing output in line with demand. Detailed port scheduling shortens ship lay times and helps avoid huge penalties for delivery delays. The material tracking and quality management system combined with a laboratory information manage-

ment system gives operators clear quality routing with blending functionalities. The result is qualified, ready-to-ship ore, accompanied by the required certification. This minimizes the necessary assets, inventory and energy requirements.

Using the latest industry standards for MES systems (ISA S 95), typical functions are available, for example for production order management, inventory and equipment handling, data history, KPIs like overall equipment effectiveness (OEE), energy management, mobile and web-based HMI, and enhanced reporting tools. The offering also extends to fleet management, 3-D stockpile handling and statistical process control. The modular approach permits step-by-step implementation according to the needs of the mining company. Furthermore, it allows future extensions and upgrades, and a short implementation time. Simine Automation and MES is equipped with pre-configured applications and now covers at least 80 percent of the requirements for production processes – from excavating and transport to crushing, shipping ►►



#### Mining out of the box: preconfigured applications are at the heart of Simine MES

This overview portrays all MES functions covered in the Mining in a Box concept. In the ERP area the functions are shown that need to be connected with the execution level. Simine MES provides standard connectors for different ERP interfaces. Behind each of these MES function blocks one or more libraries are used to fulfill the required functionality.

**This approach enables scalable MES solutions with a fast return on investment and low total costs of ownership.**

- and secondary processes such as water treatment. This approach reduces the configuration effort and enables scalable MES solutions with a fast ROI and low total costs of ownership.

#### New minerals automation standard based on Simatic PCS 7

Simine Automation is based on Simatic PCS 7, the process control system from Siemens for all process industries and one of the leading process con-

trol solutions worldwide. The specific minerals automation standard and the minerals library provides a predefined engineering approach with a process-oriented configuration and engineering strategy for the mine process. It includes typical functionalities for the control and visualization level and helps to streamline and optimize the engineering process. Open system architecture in line with industrial standards supports seamless integration of equipment like field devices, drives,





With nearly 100 years of experience in the minerals industry Siemens is the perfect partner for optimizing operational efficiency

motors, MCC's, CCTV and vendor packages based on third-party controllers. Fieldbus Foundation and Profibus PA are fully integrated and guarantee – together with Industrial Ethernet, Profinet, OPC, IEC61850, Modbus and Industrial WLAN – the open system architecture of the minerals automation standard. An automation controller with highest IO performance, extremely reliable components and the possibility for full redundancy on all automation levels ensures highest availability whenever needed.

Special solutions like remote operation center, plant asset management, power control integration and advanced process control are seamlessly integrated in the minerals automation standard. A single system for process and power control leads to an easier and faster engineering approach, reduced training efforts for operator and maintenance personnel, and better process transparency. Integrated

asset management including mechanical equipment with automatic generation of the asset information based on the process hierarchy and the automatic feedback of intelligent devices helps to avoid unplanned downtime and supports the planning of preventive and predictive maintenance. A free-of-charge advanced process library (APC) helps to easily and cost-efficiently implement APC applications. These offer the full advantage of an integrated solution with the same look and feel for operators. Furthermore, predefined APC packages for several process steps are available. ■

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■ Automation technology

# Trends in automation technology in the construction materials



Thomas Walther,  
Head of Sales & Marketing  
for Minerals

» In the cement industry, reliable processes are crucial to success. Siemens offers highly innovative automation and distributed control systems. «

Thomas Walther  
Head of Sales & Marketing for Minerals

Nowadays, industrial automation technology is essential for the production of construction materials. It is used in small-scale plants, for example in quarries, concrete and asphalt mixing plants, and complex cement plants. Automation technology can help reduce production costs and increase productivity in plants. Automation solutions help to make the manufacturing process safer and more efficient. The processes can be further optimized and the plant availability can be increased by means of suitable measuring technology and the associated control components.



# logy and in industry

If you look at industrial plants, you will quickly notice that many forms of energy play a more or less important role, depending on the industry. One thing that is common to all industries is the considerable influence that these energy carriers have on the price of the end product and thus its position in the market. If a company succeeds in constantly putting these influencing factors to the test and optimizing them, it will obtain and solidify its own market position and simultaneously make a decisive contribution to environmental protection. Thus, the appropriate automation technology makes an important contribution toward protecting the environment, efficiently using energy and raw materials, and reducing emissions.

Today it is impossible to image production of construction material without industrial automation. You find automation technology in small plants like quarries, concrete and asphalt production plants and in complex cement plants. With automation technology you can reduce production costs and increase plant productivity. Automation solutions help to make production process safer and more efficient. Using applicable measuring technology and proper control components, it is possible to optimize the process and increase the availability of the plant.

If we are looking at industrial plants, we recognize very fast that all sorts of energy forms play a more or less important role, depending on the line of business. The significant influence of energy on the price of the finished product and thus the position in the market is ultimately common for all industries. If it is possible to put these factors again and again to the test bed to optimize and secure one's own market position, at the same time it is possible to provide a significant contribution to protecting the environment. Consequently, with proper automation technology you make a significant contribution to conserving resources, efficiently using energy and raw materials, and reducing emissions. ►►

Lafarge Cement Plant, Hungary



## » Today, the **Totally** Integrated Power portfolio from suppliers like Siemens ranges from planning tools to a coordinated hardware portfolio. «

### » Development and reasons for automation

Automation technology is the backbone of industrial production. It makes plants safer and more productive. Almost 50 years ago, electrical engineering was integrated into automation technology thanks to the transistor. This was a very rapid development that no one could ever have imagined. Then as now, the main reasons for automating a process or production plant are:

- The improvement and homogenization of product quality
- Cost reduction (personnel, energy, resources)

- Increase of the throughput rate
- Relieving personnel of monotonous or heavy physical labor

The aim of automation technology is primarily to allow machines to operate without or nearly without human intervention. The maximum level of automation is always the goal. The more the machines and systems run on their own, the greater the degree of automation – and the lower the rate of human error.

In the beginning, the application of automation technology was limited to large-scale production lines. Today it is also possible to automate even small plants through the use of more flexible automation technology.

The first electronic controllers were hardwired systems. Flexibility was correspondingly low and functionality was extremely limited. The new transistor, with its signal-amplifying function, triggered a real boom in automation. As early as 1955, Siemens developed the first control circuits using germanium transistors. In the mid-1970s, the transition from wired to PLC technology led to a paradigm shift in control technology. The control task was now saved as software in the form of programs and blocks. This allowed changes to be made independently of the

Lafarge Cement Plant, Hungary





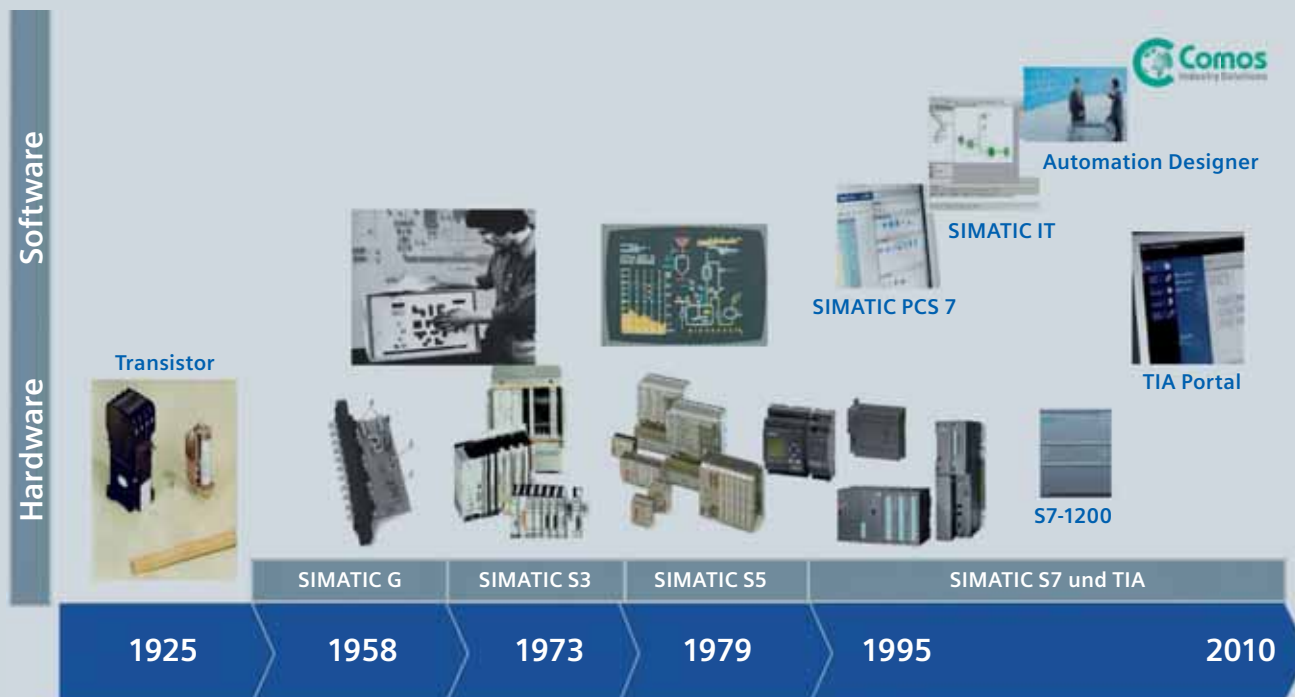


Fig. 1: Development of the automation technology (in this case, using the example of the Siemens portfolio) has led to increased product quality, better utilization of materials, less use of energy, and thus to lower costs and better protection of the environment in the construction materials industry

hardware and it increased functionality, which opened up completely new applications for automation technology. In the mid-1990s, the introduction of Totally Integrated Automation in the Siemens portfolio provided an additional impetus: Characteristics such as integrated configuration, integrated data management, and integrated communication determined the competitiveness of an automation solution. Topics such as operator control and monitoring, communication via bus systems and networks such as Profibus or Industrial Ethernet, and integrated engineering in distributed automation structures also became increasingly important. Automation and drive technology were largely independent sectors until the mid-1990s. Only the general use of fieldbuses and their functional expansion to include isochronous operation and direct data exchange between the sectors created the basis for the increasing integration of drives and automation. Now it became possible not only to program connected controllers from a programming device or PC, but also to implement "intelligent drives" via one and the same bus.

This meant that it was no longer difficult to also integrate the distribution of electric power within an automation system into the automation concept. Today, the Totally Integrated Power portfolio from suppliers like Siemens ranges from planning tools to a coordinated hardware portfolio: From switchgear and distribution systems for medium voltage to trans-

formers, switching and protection devices as well as switchgear and busbar trunking systems for low voltage, all the way to small distribution boards and cables and connectors. The products and systems can be safely connected to the automation system over almost any distance via communications-capable switches and interface modules. This allows the entire optimization potential of an integrated automation solution with regard to energy consumption to be exhausted, from planning, configuration, programming and installation to operation. (Figure 1) »

**» The digital factory shows that the changes in automation have not yet come to a standstill. «**

Fig. 2: Thanks to the use of Mobile Panels as seen here for the extraction of graywacke in the Treis-Karden quarry, mobile sub-systems can be integrated into the plant automation via industrial wireless networks (IWLANS)



#### » Goal: digital factory

Future topics such as the digital factory show that the changes in automation have not yet come to a standstill. At the heart of the digital factory is the digital planning of production sequences and the saving of the system structure, its devices, sequences and processes on the computer in digital form and to operate them as cost-effectively as possible. Today's software tools rely on a common interdisciplinary and consistent database, which integrates the various engineering data from mechanics, electronics and automation in one plant structure and intelligently manages modularity, standardization and library concepts. In the process, the software overcomes the previous boundaries between all of the participating disciplines and combines the mechanical, electrical and control-related system planning for a time-optimized layout and engineering phase, and the consistent documentation of a production plant.

Regardless of the tools used in the planning process, all of the data is compiled in a digital engineering system and used further in a uniform user interface in the operational process chain; this ensures uniform data management, from planning to production.

Such software tools (e.g., Comos software from Siemens for lifecycle engineering and plant asset management) also allow automated, standardized working, the reduction of coordination effort, and an increase in the quality of the results with considerably less effort thanks to, for example, the reduction of transmission errors. Due to the object-oriented structure of the software, it is possible to respond quickly to individual requirements. Parts of the application that have already been created can simply be reused. This ensures current and consistent documentation, which can be called up at any time during the creation and operation of the plant.





## Automation in the preparation of bulk materials

One of the most modern quarries in Germany can be found in Treis-Karden, on the Moselle River. Based on the example of bulk material extraction, an automation solution from Siemens that allows the operator to achieve an unusually high level of productivity is described in the following. Mosel graywacke, which is primarily used as bulk material for road building, is broken up at Treis-Karden. The new automation solution gives the operator the capability of producing chippings for either concrete or asphalt. The material flow of the entire system is controlled by a Simatic S7-300. The Simatic ET200S distributed I/O systems, some with IM151 intelligent interface modules, are assigned to the individual units. The operation of the plant is visualized via two Simatic Multi Panels. Extensive, partially concealed and difficult-to-access subsystems with a frequent need for maintenance are the typical application area of wireless Simatic Mobile Panels. Wireless communication was not used in quarries in the past because it was feared that the radio waves might be subject to interference from the many steel supports, beam constructions and silos. Two access points – one at the pre-crusher and one near the silos – specify the effective ranges and are currently completely sufficient for operating the Mobile Panel at all relevant points in the system. A third access point is provided to expand the system. (Figure 2)

The HMI software (Simatic WinCC) for simple and clear visualization runs on both the Multi Panels and on the Mobile Panel. The display and operating options of the Mobile Panel are identical to those of the two stationary panels. Plant operators receive current diagnostic messages from the entire system in this way, allowing them to immediately respond and thus prevent or at least considerably reduce downtimes. The work that previously required two plant operators can now be carried out by just one. This increases productivity as well as operational reliability.

Another example of modern automation technology in the construction materials industry is the open-air, contact-free level measurement of bulk materials; ultrasound technology is extremely well suited for this. Ultrasound is ideal for these applications because:

- The rugged, encapsulated sensors are extremely resistant to shocks and vibrations

- The highly active sensor/transmitting surfaces are self-cleaning in environments prone to some dust
- The narrow beam angle of each ultrasound sensors can be aligned to a specific level of material (Figure 3)

In recent years, radar technology has also gained wide acceptance in measurement technology. It is experiencing considerable growth in applications for bulk materials and has even become the preferred level measurement technology in the cement industry for dust-intensive applications with large measuring ranges. The success of radar devices in extremely dust-intensive applications can be traced back to the use of electromagnetic waves in the microwave spectrum. A 4-wire FMCW radar-level measuring transducer, which works with 24 GHz and a very high signal-to-noise ratio, provides expanded signal processing for the continuous monitoring of bulk materials with a measurement distance of up to 100 m. It is therefore ideally suited for measuring where there is an extreme amount of dust such as in cement silos.

## Further potential areas for developing automation technology

The construction materials industry can anticipate additional rationalization possibilities in the near future due to the following trends:

- the continuing, progressing decentralization
- the continuing advances of Ethernet at the field level
- the increasing intelligence of the field devices and drives, resulting in diagnostic and maintenance capabilities
- new, low-cost sensors



**Fig. 3:** The contact-free level measurement of bulk goods using ultrasound technology in the open, as in this case, or in a dusty and harsh industrial environment, allows optimal, uninterrupted and precise checks of quantities and quality

- The increase in wireless communication
  - The further vertical integration with company-wide networking of operational processes
  - The optimization of plant processes (advanced process control)
  - The increasing use of energy management systems
- Some of these trends are further explained in the following:

#### Wireless communication with Ethernet in the field level

Thanks to wireless communication with programmable controllers, even greater flexibility is achieved, maintenance work is simplified, and service and standstill times are reduced. Since the Industrial Ethernet standard Profinet can also be used for wireless communication via Industrial Wireless LAN (IWLAN), new application fields are opening up. Equipment that is prone to wear, such as contact wires, can be replaced by intelligent communication technology. The use of driverless transport systems and mobile HMI devices is also made possible with this technology. In addition to the deterministic data exchange via Profinet, the IWLAN connection can also be used for additional communication tasks via standard services such as TCP/IP. In this way, moving machine parts can also be seamlessly integrated into a system. The reliability of wireless communication is essential. IWLAN is based on the proven standard IEEE 802.11 and can be used in industrial environments without any problems. Even safety applications in combination with Profisafe can be implemented in IWLAN without additional overhead. Profinet combines the advantages of the proven Profibus and Ethernet standards.

#### Energy management systems and optimization of plant processes

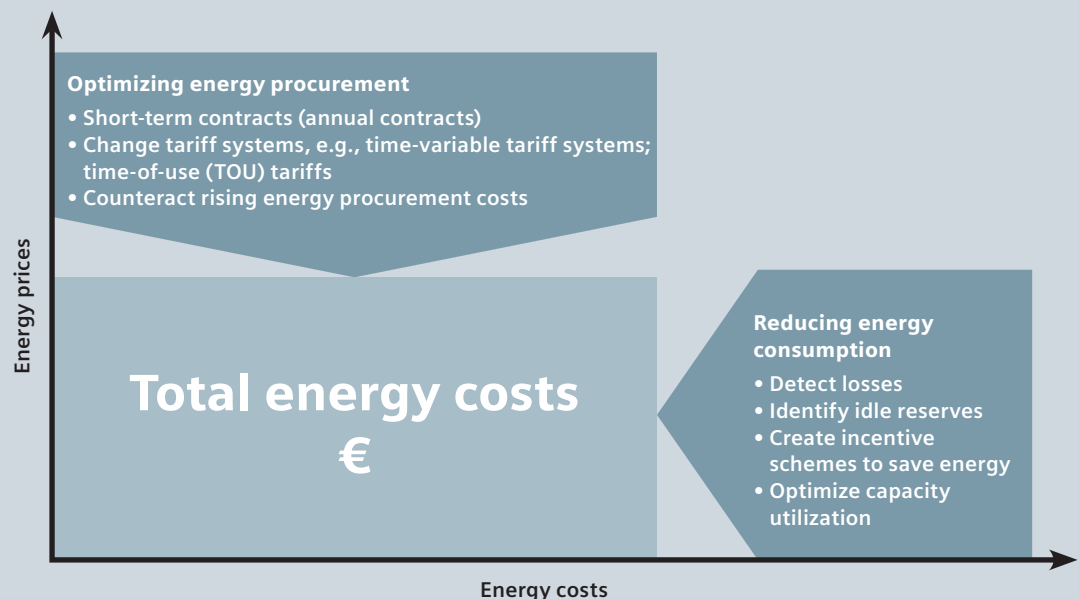
The diversity of various products and methods that are used in production and the partially highly sensitive production processes require a reliable and efficient supply of energy and raw materials. Regardless of which form of energy (gas, water, compressed air, etc.) is being considered, the system for efficiently using and optimizing energy is always the same. There are four possible optimization paths for electrical energy alone:

1. Introduction of an energy management system
2. Determination and use of the optimum drive solution (fixed speed or variable speed)
3. Use of energy-saving motors
4. Industry-specific process optimizations

An energy management system allows savings in both procurement and in the use of energy. If you imagine the influencing factors are in a coordinate system, you can clearly see how the different factors stand out. (Figure 4)

When optimizing systems, it soon becomes clear that losses can only be detected if the consumption levels of the different parts of the system are known in detail and can be compared. Modern energy management systems are based on standardized components, which are present in large numbers in the system and can thus be easily and effectively used for recording. In addition to recording the electrical energy, all other forms of energy should also be recorded in order to create overall transparency, because energy management is implemented on many levels in an industrial plant. Beginning with the field level, the required basic data is acquired via corresponding sensors in order to later be prepared and compressed in the assigned controllers. This data is

Fig. 4: Factors influencing overall energy costs







Control Center at Lafarge Cement Plant, Hungary

now made available to the operators. This also includes the defaults of the load management for the connecting and disconnecting of plant units. The control center personnel can generally accept these defaults or decline them (during critical system situations) or move them within the value range (temporarily).

Procuring the required energy is becoming an increasingly important topic, especially for energy-intensive industries such as the cement industry. In this case, the purchasing department needs sound scenarios that illustrate the process as precisely as possible. This also includes, for example, modules that allow various consumption profiles to be calculated so that sub-areas can be optimized. Operators will only be able to qualitatively plan budgets if they are in a position to generate correct energy forecasts. This planning security puts the end consumer in a strong position to effectively negotiate with the energy supplier. If an energy schedule is negotiated with terms of purchase, this schedule can be sent via the system's energy management system to the load management system. Even if an energy management system was introduced into a system, the optimization work is still not finished: Currently only the basics, i.e., the aids and tools, were created for getting closer to the actual goal of an energy-efficient system.

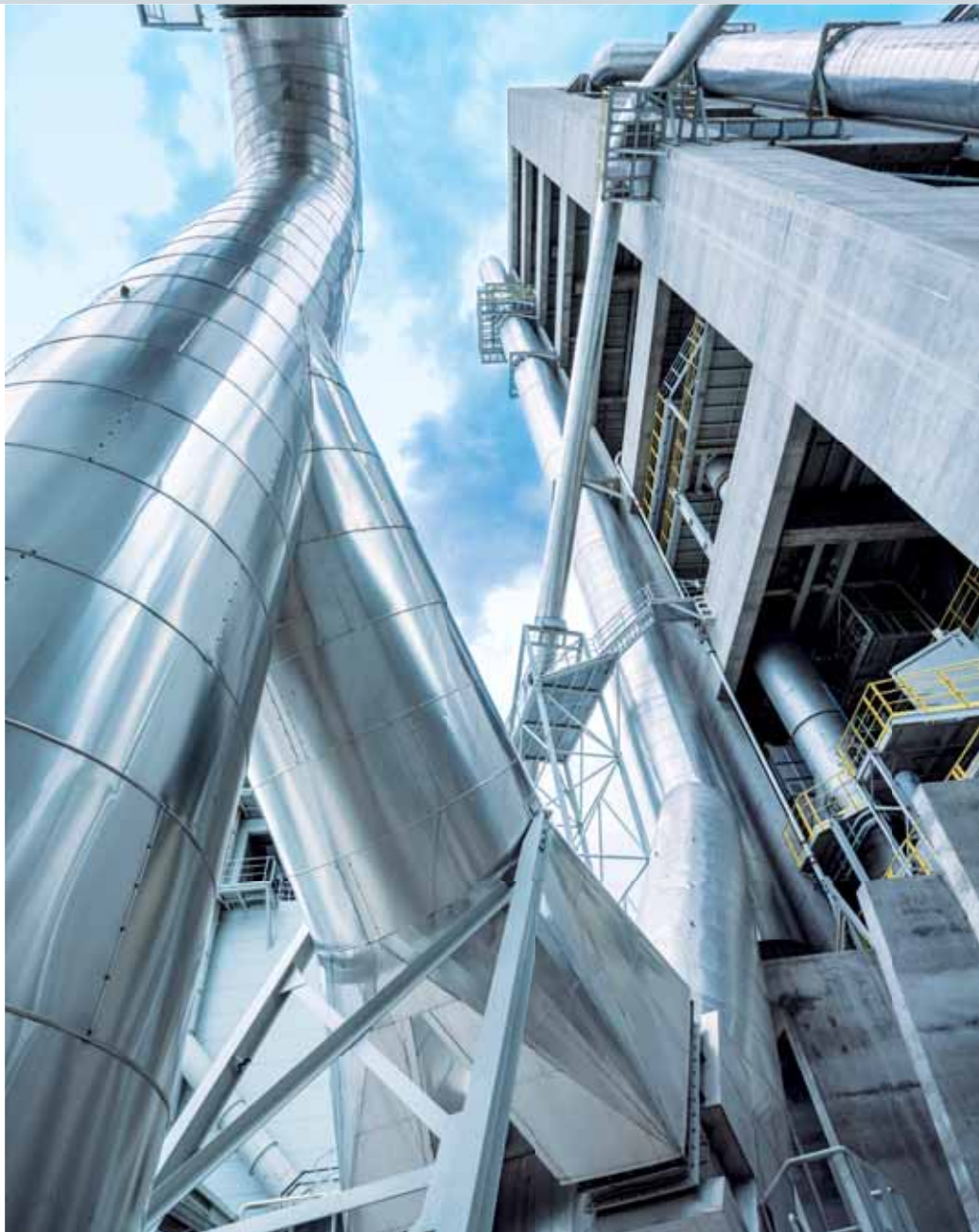
Modern automation technology also provides support in cement plants in the energy management of secondary fuels. Intelligent software modules (e.g., the Cemat Fuel Manager from Siemens) can be integrated into existing control systems relatively easily in order to optimize the fuel dosing of primary and secondary fuels in such a way that (here too) the burning process is highly efficient and energy costs can thus be reduced.

### Stabilizing quality and saving time

With the assistance of software tools (e.g., neuro-fuzzy and model-based predictive control (MPC), process parameters can be determined more quickly and thus, for example, the quality of cement mills can be optimized. A neural soft sensor records the process input values and makes a fineness prediction of the quality of the milled material in the cement mill; this occurs in real time. The determination of the fineness in the laboratory takes a few minutes and thus the laboratory value is only conditionally available for quick regulating. To reduce process deviations and stabilize the grinding process, Model-based Predictive Control is used. This control tool has a complete model of the process dynamics with all interconnections. The combination of a neural soft sensor and an MPC system takes account of the complex character of the grinding process in a special way. The result is a more uniform grinding process, which optimizes the throughput of the mill while retaining the same desired quality. It also makes the plant operator's work easier. All of these measures must be regularly checked and improved in order to remain competitive, to efficiently operate a system/plant and to meet legal requirements. Throughout the entire process chain, described only in part here, from the crushing of the raw material to the end product of a cement mill, it will always be the attentive worker who recognizes further potential areas for savings and who uses these findings to implement additional measures. Thus, the appropriate automation technology makes an important contribution toward protecting the environment, efficiently using energy and raw materials, and reducing emissions. ■

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■ Innovative drive concept for the cement industry

# Higher reliability, better performance

Compared with conventional solutions, a new drive concept with asynchronous squirrel-cage motors at the Lafarge Cement plant near Pécs, Hungary, boasts minimum service and maintenance costs. And if that wasn't enough, higher efficiency is also helping improve the bottom line.

Normally, slip-ring motors with resistance or liquid starters in the rotor circuit are used in the main drives in vertical mills. The advantages of slip-ring motors include among others low start-up current, which the starter limits to around twice that of nominal current, and relatively high starting torque. In fact, the cement industry is almost the only one in which slip-ring motors are built into new installations – mainly due to experience gained in the past as well special requirements like fixed-speed drives with relatively high starting torque and the resulting high network stress. To ensure safe operations, intensive maintenance is necessary for the starter as well as for the required brushes and corresponding equipment.

But back in 2007, during the tendering phase of the Lafarge Cement Hungary project, project leaders were looking for a drive system that required lower maintenance. The solution: replace the commonly used slip-ring motors with squirrel-cage motors. One stipulation, though, was that performance had to remain the same. Siemens stepped up to the challenge. An initial idea was to employ frequency inverters with squirrel-cage motors. However, the almost doubled capital costs could only be justified if there were benefits for the process from permanent variable speed operation of the drives. This was not the case, so Siemens in cooperation with the customer looked

for further solutions to employ squirrel-cage motors at a reasonable cost level. In the end, instead of the industry-wide practice of using medium-voltage slip-ring motors with the corresponding starters, in the new cement plant Siemens employed standard squirrel-cage motors with medium-voltage soft starters. These soft starters are fed directly from the 11 kV voltage level. For the 1,700 kW raw mill main drive, a medium-voltage soft starter with a bypass contactor was chosen. After the motor is started up, it is connected via the built-in bypass contactor directly to the 11 kV network. Since the soft starter is then removed from the power circuit, unnecessary losses in the soft starter during continuous operation are avoided.

#### An increase in power

The new drive concept enables medium-voltage squirrel-cage motors – which are inherently robust and nearly maintenance-free – to be used as the main drives for vertical mills. As a result, operators no longer have to pay for typical maintenance for slip-ring motors, for example for the replacement of carbon brushes, slip rings and filters in the slip-ring area. Furthermore, starters are no longer necessary, which also reduces maintenance expenditures. The soft starter used in the new solution is maintenance-free. Thanks to the squirrel motors used and the bypass feature of the medium-voltage soft starter, ►►



View of Lafarge cement plant in Hungary



- the drives' efficiency increases compared to a slip-ring system. This leads to substantial savings considering that the electrical power demand of mill drives is in the range of several megawatts. In regard to price, the squirrel-cage solution was realized for the same price as one with slip-ring drives. The drive concept for the two cement mills is quite similar. However, one medium-voltage soft starter for the consecutive start-up of the two mill motors is used. For this, the soft starter is toggled between the two motors with the help of vacuum contactors. After the motors have been started, the soft starter is also taken out of the power circuit by connecting the motors directly to the line via circuit breakers.

Nevertheless, due to the still rather high inrush current of almost three times nominal, a relatively strong medium-voltage network is a prerequisite for this new drive solution.

### Gentle start-up

The gentle, controlled start-up of the vertical mills offers considerable advantage for Lafarge Cement. The burden on the drive train's mechanical components, for example the clutch and gears, is reduced substantially. This is especially so with the use of

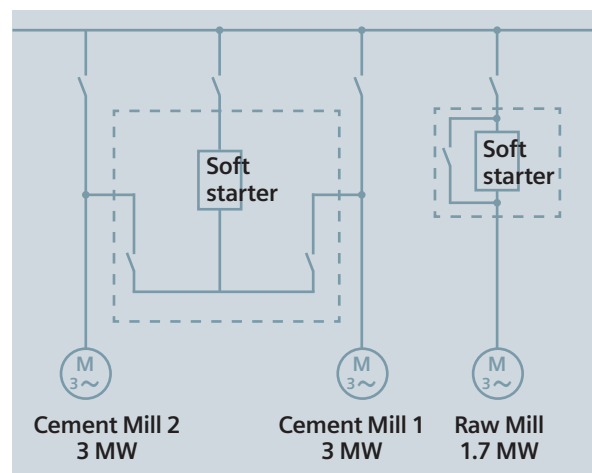
highly modern digital soft starters, which enable gentle and stepless starts. The start ramp, start-up current and time are programmable and can be optimally adjusted to the drive train of the vertical mill. The medium-voltage soft starter can be adjusted so that shortly before start-up a low voltage is transmitted to the motor. As a result, the backlash of the gearbox wheels is closed, which protects the gearbox considerably. Along with incorporated comprehensive motor protection, the medium-voltage soft starter also monitors itself. In addition, the start-up current can be limited to a maximum of 2.7 times the rated current, which in turn leads to a voltage dip of only

about 7 percent in an 11 kV network for 6 seconds. Thus the medium-voltage network is loaded only marginally when the mill drives are started up. Furthermore, the soft starters are connected into the process control system via Profibus DP. In this way, all relevant operation data and disruption reports can be reliably transferred and processed.

In summary, Siemens successfully realized an innovative drive concept that was already proven in praxis. Maintenance-intensive slip-ring motors have been exchanged for almost maintenance-free, standard squirrel-cage motors. In addition, the higher efficiency



Squirrel-cage motor from Siemens



Single-line diagram of the mill drive solutions



**Preheater tower and clinker silo**

of the new drive system has helped Lafarge Cement Hungary save considerable amounts of energy. Mill operators have reported a significant drop in maintenance costs and an increase in reliability – both thanks to the innovative drive system. Furthermore, the substitution of the drive system has had no negative impact on the grinding process. ■

### **Lafarge Cement Hungary**

Lafarge Cement Hungary, formerly Nostra Cement, is part of Lafarge Cement CE Holding GmbH, a joint undertaking of the French group Lafarge, a world leader in building materials, and the Austrian construction company Strabag. The majority of cement produced at the site some 20 km away from Pécs, Hungary, is destined for the domestic market as well as to cover Strabag's own needs. The Lafarge Cement Hungary site, which was built for around €270 million, produces some 2,500 tons of clinker daily.

By mid-2010 Siemens supplied the electrical equipment for the site, and at the beginning of 2011 commissioning took place. The Siemens scope of delivery included among others drive systems for three vertical mills, a raw mill with a drive power of 1,700 kW, and two cement mills with a drive power of 3,000 kW each.

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■ Software solution Sicement IT MIS V1.7

# Energy management lowers costs



Siemens offers support with the implementation of certified energy management in cement plants



Electricity usage is one of the most important cost factors in the cement industry. In fact, the cost of electricity has a direct impact on the price of cement. Therefore, all measures need to be taken to reduce expenditures for electricity. According to a recent study from Roland Berger Consultants, electricity prices are expected to increase 70 percent in the next 20 years. Furthermore, levies arising from the Renewable Energy Sources Act (EEG) are a sizeable burden for German cement works. Siemens has developed information management system Sicement IT MIS V7.1, a software that collects and analyzes data from all energy sources and helps to identify savings potential. The software forms the basis for requests to limit the EEG levy.



Electricity is more expensive in Germany as a result of levies imposed in accordance with the Renewable Energy Sources Act (EEG). Producers who feed regenerative electricity into the public grid receive from the grid operator a legally specified remuneration for a fixed number of years. Conversely, the electricity supply companies calculate the difference between the rate of remuneration and the market price of the electricity and pass the costs on to end users. The levy is currently 3.592 ct/kWh. In order to minimize the impact for especially energy intensive industries such as for raw materials, metals and cement as well as for the oil and gas industries, the Federal Office of Economics and Export Control (BAFA) initiated a scheme to lower the levy. To qualify, companies must submit an application. The goal of this special compensation defined under article 40 et seqq. of the EEG is to sink electricity costs so that these intensive electricity consumers can retain their international competitiveness. When certain conditions are met, the levy can be lowered to 0.05 ct/kWh. Since the beginning of the year, certification of energy management according to EMAS or ISO 50001 must also be submitted. ISO 50001, which is widely employed for all sectors, is the first internationally recognized standard for energy management systems. It unifies global regulations for energy management beyond the extent of European Norm EN 16001. ISO 50001 provides a framework for industrial facilities, commercial systems and entire organizations in order to efficiently manage energy. Effective April 24, 2012, norm DIN EN 16001 was withdrawn and replaced with the international norm DIN EN ISO 50001.

### **Paving the way to efficient energy management**

With Sicement IT MIS V7.1, Siemens offers a corresponding energy management system. The data capture and analysis system based on industry standards can gather and evaluate operational, process and quality data as well as electricity usage. The system is also capable of retracing products and ensuring quality. The electricity data are archived in a SQL





Sicement IT MIS V7.1 serves as the basis for the acquisition and analysis of all energy sources and all facilities that use energy. It also helps to assess potential energy savings

- » database in a separate manipulation-proof computer. Via the client/server architecture, all archive data for display, analysis and optimization are available across a company. For example, real-time trend curves can be viewed on an office PC. The user can also access a range of possibilities for the display (viewer), evaluation (protocols), trends, analysis and optimization

## Shutting off a screw conveyor in a cement plant during mill standstill can help save around €70,000 per year in electricity costs.

(tables, graphics). As a result, reports can be created automatically, for example on energy use, production, quality and even on emissions. Cement plant management has all relevant information at hand to make important decisions. A range of interfaces is available to integrate different process control sys-

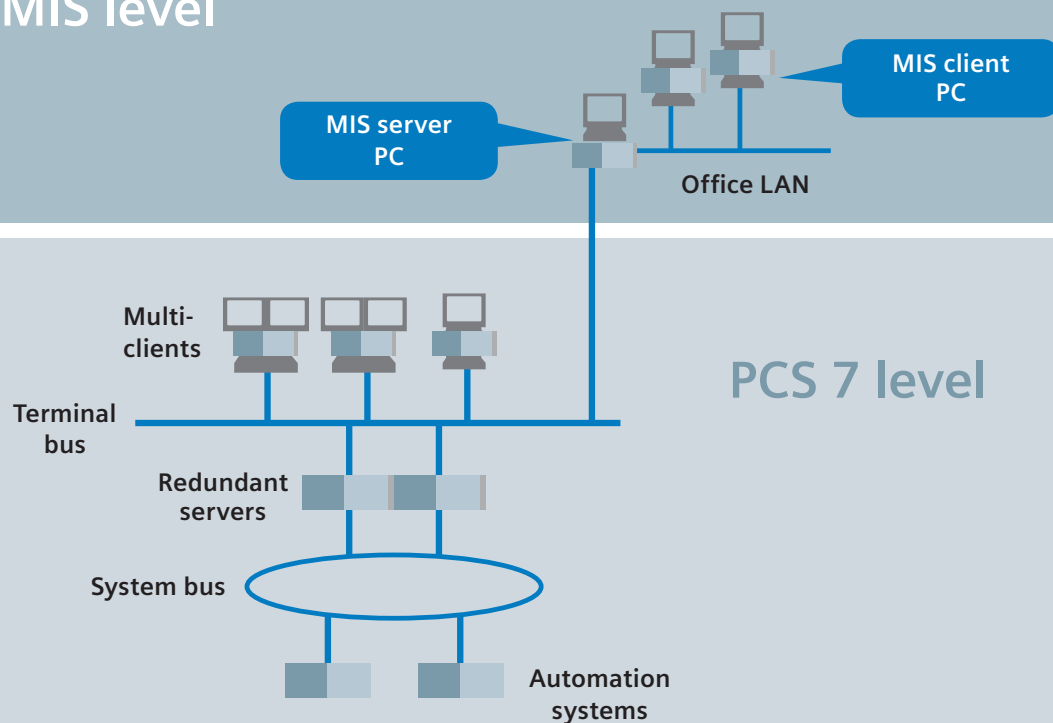
tems and applications. For example, interfaces for Simatic PCS 7, Simatic S7, databases, OPC server and special solutions for third-party systems are included.

### Certified energy management

The application to limit the EEG levy, which electric companies pass on to energy consumers, can be supported with analyses and verifications produced with Sicement IT MIS V7.1. The system records and analyzes all energy sources as well as all facilities and components that use energy, and calculates potential to save energy. In addition, it produces energy reports according to the requirements imposed by the certification authority of the Federal Office of Economics and Export Control (BAFA). The application to limit levies under EEG must be renewed every year with BAFA by June 30. For a given fiscal year proof has to be supplied that the electricity bought from a power company and used at a single location exceeds 10 GW/year. In addition, the relationship between a company's electricity costs and gross value added must be over 15 percent, and the amount of electricity is proportionately passed on to the company and used by the company itself. Furthermore, certification has to be issued that energy usage and potential to reduce energy consumption has been ascertained and assessed. The Siemens tool is



## MIS level



Typical system architecture

also helpful for preparing the documentation for the certification authority, for example GUTcert or TÜV.

### Continuous improvement

In just about every company, energy inefficient processes can be found. Whether no-load losses, facility oversizing, lack of control or leaks, the result is unnecessarily high energy costs for manufactured goods. The primary goal of a facility operator should therefore be to use less energy by optimizing use and at the same time to create the framework for maximum refund reimbursement, and to use the market mechanisms for cost-optimized energy purchasing. Sicement IT MIS V7.1 helps to find this potential. The system is in a position to centrally collect, process and archive data from different control or automation systems. For example, the counter values for output and energy usage can be calculated cyclically and allocated to the different cement types produced. With this information, furnace processes can be optimized, the efficiency of pumps and filter technologies improved, pressure losses and leaks recognized, and unused aggregates shut down. For example, shutting off a screw conveyor in a cement plant during mill standstill can help save around

€70,000 per year in electricity costs. Clinker production reports, long-term trends concerning energy use in a cement mill and the long-term monitoring of the clinker quality, the free lime content and the clinker minerals help the operator to continuously improve production processes. Furthermore, this data aids in running a facility more cost efficiently as well as to more easily locate areas for improvement. For example, by evaluating fluttering messages, recurring disturbances can often be better recognized, or the frequent switching and starting of running parts can be optimized. With the user-friendly interface as well as the automatically integrated reports, the operator additionally has at all times access to all relevant information. Together with Siemens consultancy and maintenance services, Sicement builds the foundation for the deployment of an efficient energy management system. ■

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■ Expert system Sicement IT MCO

# Higher throughput with lower energy consumption

The milling process in a cement works is very energy intensive and accounts for almost 45 percent of electricity consumption. With the Siemens expert system Sicement IT MCO (Mill Control Optimization), the operator can sink energy use, optimize cement mill operation and improve clinker quality.

For the quality of cement, it is important that ground material is as fine and uniform as possible. Therefore, for quality control samples are regularly taken and analyzed in the lab. According to the established fineness of the ground material and the throughput of the returns, operational parameters such as the supply of new volumes and classifier speed are continuously adjusted. However, due to changing

production conditions the operating point is not fixed, but has to be reset according to current measurements. Depending on the condition of the mill, a different response may be necessary to ensure that the facility is operated with as little intervention as possible. And when intervention is necessary, it should be on the dot.

Until now statements on the quality of the cement could only be made in certain intervals after testing in a lab. Now, the expert system Sicement IT MCO can continuously deliver the required values. The system analyzes all current facility data and operational parameters relevant to quality, such as classifier speed, the quantity of fresh material, the separate flap position, circulating bucket elevator power, performance of the mill drive, data from electric ear chambers 1 and 2, mill temperature and recipe type. As a result, the expert system provides respective set points to the already available controllers for the basic automation, which ensures that the mill is run according to the optimum operating point.

## Soft sensor improves quality and throughput

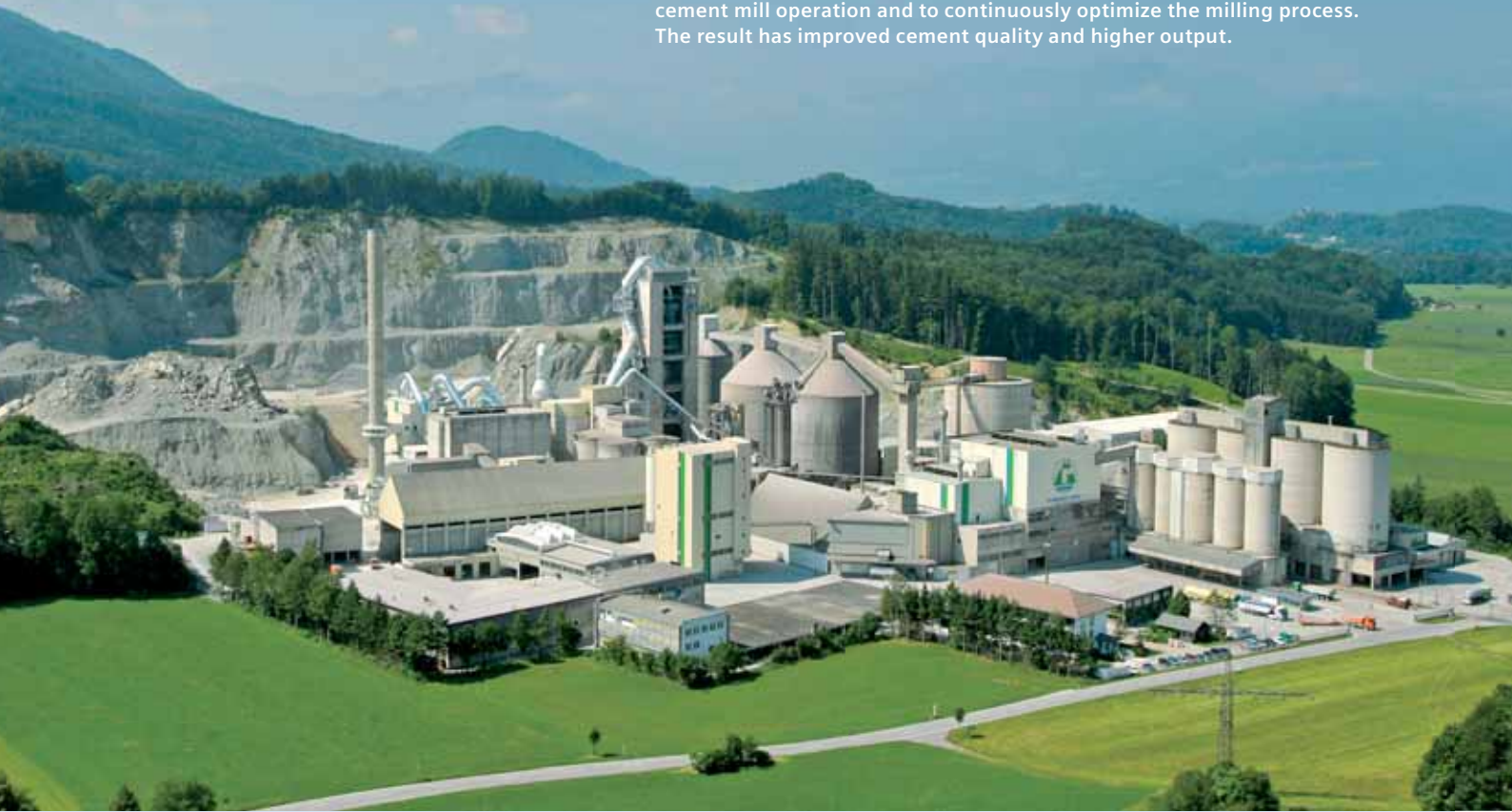
The Siemens software uses components of the APC (Advanced Process Control) library from Simatic PCS 7, a neuronal soft sensor and model-based predictive control (MPC). The neuronal network comprises neurons arranged in layers, and each neuron is defined by an input and an output variable. The control model is derived from measurements and is developed based



A bird's-eye view of the Südbayerisches Portland-Zementwerk, where Sicement IT MCO was employed for the first time.



Thanks to new control software, it is possible to make predictions about cement mill operation and to continuously optimize the milling process. The result has improved cement quality and higher output.



on its transmission behavior. After the teach-in phase, the controller has at its disposal an internal, complete process dynamic model with all links. Using input parameters such as fresh material or the chosen recipe type, a prediction can be made about the cement's fineness. The forecast value for the fineness of the cement and the throughput of the return form the variable for the subsequent MPC, which brings the variables as close as possible to the optimal set points. Mixing variables and the classifier speed are iteratively changed, which thereby optimizes the facility's behavior.

#### Use in the Südbayerisches Portland-Zementwerk

Sicement IT MCO was employed for the first time in one of the four ball mills at the Südbayerisches Portland-Zementwerk in Rohrdorf, Germany. The selected mill is 11.6 m long and has a diameter of 3.8 m, runs at a speed of 15.4 revolutions per minute and has a milling output of 60 tons per hour. The drive's performance rating is 2,400 kW. An important requirement was to seamlessly replace the existing system and to integrate the new expert system into the control system with minimal effort. The goal was to achieve a maximum throughput with the desired degree of grinding fineness. The expert system was implemented in three phases: Initially, the facility was analyzed to identify the required input and output variables. After that, tests were carried out in order to calculate the step responses, collect production data and develop the model for the soft sensor. In the third

phase the expert system was integrated in the Simatic PCS 7 control system and operated in shadow modus. After a successful trial run, the old system was turned off and Sicement IT MCO was improved to an extent that it delivered optimum results for every one of the eight recipe specifications.

The automatic, predictive control can now ensure stable production operations at any point in time. The result is a more uniform grinding process and a longer lifetime for the mechanical components. In this way, the mill's throughput can be increased according to the desired grinding fineness, and the facility operator can concentrate on other tasks. Furthermore, less electricity is needed to produce a ton of cement. Since Sicement IT MCO is completely integrated in the facility and the existing PCS 7 control system, no further maintenance and service costs are imposed on the operator. After introduction of the expert system Sicement IT MCO, throughput could be increased 5 to 8 percent. The investment amortizes within a period of just three months. The three other ball mills at the site will be gradually equipped with the new Sicement IT MCO expert system. ■

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■ **FLENDER MultipleDrive**

# Drive system keeps mills going

Today a clear trend can be observed toward larger single mill units. And just as important as ever is availability and reliability. For vertical roller mills Siemens offers the new FLENDER MultipleDrive, a modular drive system with an expanded power range.

Reliability is key for large mill drives in cement plants





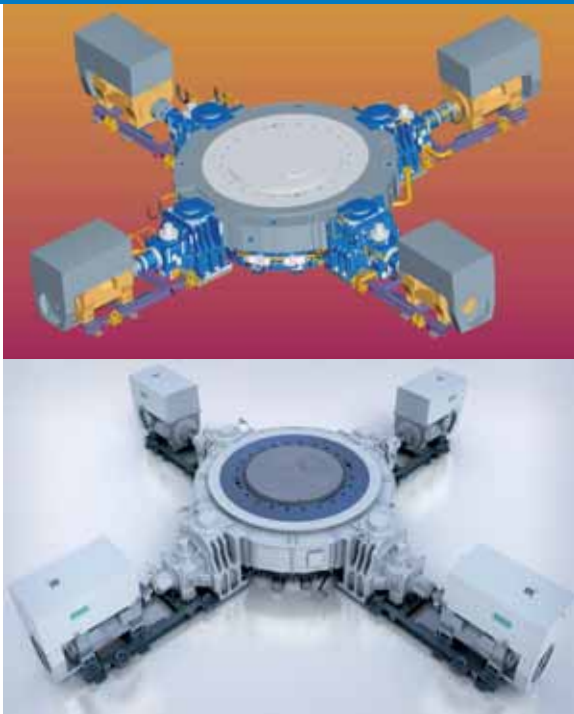


Fig. 1: MultipleDrive components

**If one of the drives requires maintenance, the mill itself can still be operated with the remaining drives.**

The concept of using modular components allows the selection of the number and size of components, which exactly match the power requirement of the application and thus achieve the most cost-efficient combination. Using MillDrive, proven components can be combined to an active redundant drive system for mill powers up to 16,000 kW. A possible combination can consist of up to six identical standardized drive units with one mill support. The advantage is that if one set of drives is not available, the mill can still be operated with the remaining drives. A further benefit is considerably reduced unplanned downtime.

The initial reason for developing the MultipleDrive concept was to come up with a drive system that matched the philosophy of the new Pfeiffer MVR line of roller mills. A further aim was to deliver high throughput and maximum availability. The MultipleDrive assists with the MVR feature of allowing continuous production even when a roller is taken out of operation. All other types of vertical roller mills can certainly also profit from the increased availability of the MultipleDrive concept.

#### All from a single source

The MultipleDrive system (Figure 1) consists of the following main components:

- Frequency converters
- Electric motors
- Couplings
- Gear units
- Mill support
- Condition monitoring system
- Overall integration in the plant control system

This entire drive system – basically from the electrical outlet to the mill and including the corresponding control software – is supplied from a single source: Siemens. The electric motor and the gearbox, connected by a coupling, are mounted on a base frame with slide rails. These components are the drive modules, grouped around the mill support.

Load distribution between the drive modules is taken care of by controls that are part of the frequency converters. The frequency converter also allows the grinding table speed to be adjusted to optimize the throughput of the particular material being ground. The mill support carries the grinding bowl. Forces coming from the grinding process are transmitted by the mill support into the foundation via slide bearing segments, just as in a conventional drive. However, the drive modules themselves only have to transmit torque and do not carry any forces coming from the grinding process, because they are located outside the mill support.

Especially with raw meal, an uninterrupted flow of material is important, since the kiln requires continuous feeding. If one of the drives requires maintenance, a drive module can be pulled out of mesh with the mill support, and the mill itself can still be operated with the remaining drives. In this way, the grinding process can continue with slightly reduced power even with major components removed.

The drive system is composed of highly standardized components: For the entire power range there are five mill supports and three drive module sizes. These are combined to match the required mill size and mill power. Spare part management is made easier and ►►

## Condition monitoring, part of the scope of supply, helps detect problems at an early stage.

- lead times are reduced since the parts used are of an easily manageable size. For example, a drive system for a 6,600 kW mill with four drive modules of 1,650 kW each uses modules weighing only 22 tons. Compared with a conventional drive, these modules are much easier to handle.

### Condition monitoring included

Condition monitoring equipment is part of the scope of supply. Condition monitoring helps detect problems at an early stage. As a result, a problem can be solved before it has a detrimental effect on the operation of the mill. Motors, drives and mill support equipment are outfitted with sensors. Data derived from the sensors, such as temperature, speed, torque and vibration, are recorded and evaluated by the Siemens Siplus condition monitoring system (Figure 2). Aside from issuing alarms if admissible values are exceeded, the system also records the data continuously and establishes a trend analysis over time. These analyses help experts appraise developments that could result in failures and to recommend specific action. The data can be evaluated

by on-site personnel as well as by a Siemens expert via an Internet connection.

The benefits of condition monitoring:

- Earlier failure detection
- Shorter repair times
- Planned spare parts procurement
- Prevention of unscheduled downtimes
- Improved planning and throughput
- Minimization of on-site visits
- Higher system availability
- Better utilization of the system potential

### Integration with Cemat

In a plant controlled with state-of-the-art equipment, only a few operators are responsible for smooth functioning of production. This means that they need a system at a higher level to collect general information from all existing sub-systems and to make it available to the operators.

Cemat, the leading Process Control System from Siemens for the cement industry, can be used to control the whole grinding process. Cemat is much more than just a database with a few cement-specific modules. It contains a complete philosophy on how to operate cement or grinding plants, and how to make diagnostics to keep downtimes to a minimum in the event of a plant problem. Special function blocks and faceplates are designed to manage all kinds of operation, interlocking and supervision functions that are typically required.

### Concept of data flow, condition monitoring system for MultipleDrive

Fig. 2: Control concept of the complete system realized for the MultipleDrive project at the Holcim cement plant in Grand Couronne

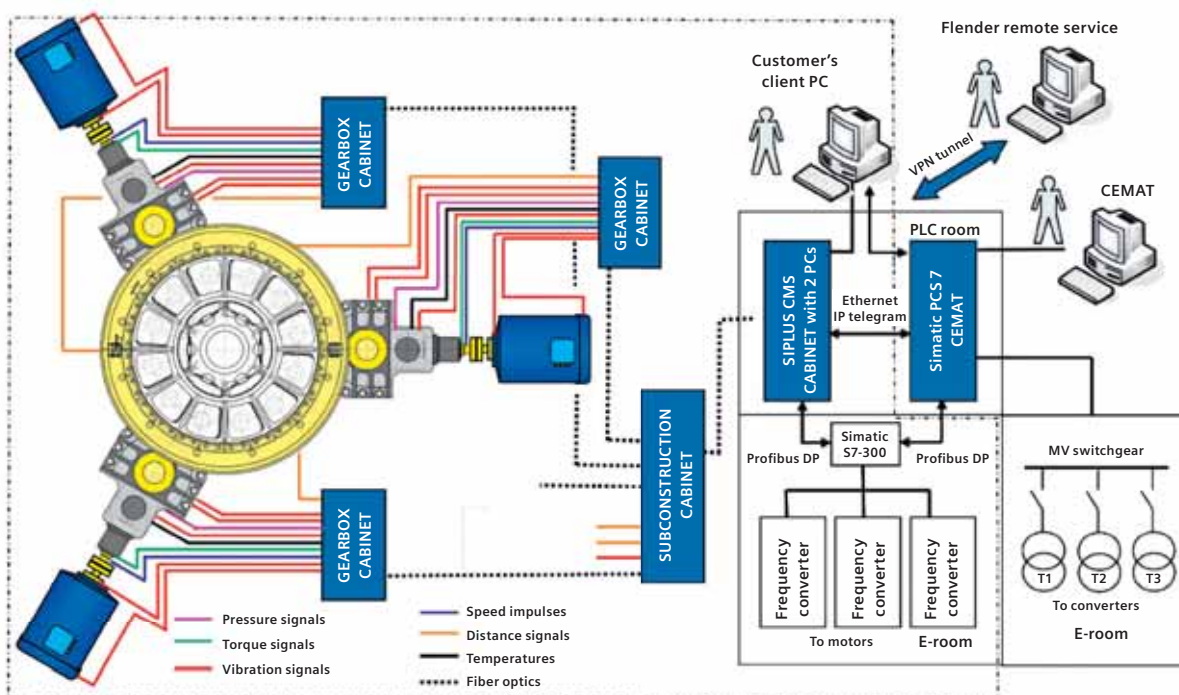




Fig. 3: Test run of the 6,600 kW mill support with a drive module

Main functions in the Cemat system:

- Supervision and control of all components, such as hydraulic pumps, bucket elevators, blowers, conveyors, etc., and sub-control systems like CMS, frequency converters and weighing feeders
- Operator support during start-up and stop sequence as well as during regular operation, set points of control loops, etc.

Optimized message functionality to reduce the operator load and to display only relevant information. All relevant sub-systems are covered with Cemat. The pre-processed signals from the CMS system or from the inverter PLC are all transferred to the Cemat process control system via Profibus DP or Ethernet communication. Within the Cemat system the data is pre-processed and archived, and it can be displayed in an operator-friendly way.

In the cement industry well-known “diagnosis pictures” from Cemat are specially adapted to the MultipleDrive functionality. The diagnostic dialog shows the inputs and outputs of the block, including status information, interlocking conditions and faults. It also permits the modification of process parameters. The operator receives comprehensive information about the MultipleDrive system in one picture and has all information at a glance. In the case of a problem with one drive module, the diagnostic picture allows a very fast pre-selection of the remaining modules. After pulling the drive module out of mesh, production can continue.

MultipleDrive functions of the diagnostic picture:

- Drive mode selection (all three, or two out of three)
- Welding mode selection (preselection of a very slow speed for maintenance)
- Status of all drives

- Status in general for start-up or operation
- Status of CMS

Status of communication with the sub-systems. Other Cemat diagnostic pictures provide a compressed overview of the diagnostic properties of CMS and generate corresponding messages for the alarm system. This picture shows only a differential value of signal amplitudes between the commissioning status and present situation. This means that the operator can obtain a very fast overview, even without in-depth knowledge of the CMS system. Finally, for the operator there is no difference in regard to how many drive modules are connected to the mill. There is no additional work to do because it is handled by the Cemat control system. The complete system increases plant performance, reduces downtime and saves costs. Integration into the process control system provides plant-wide information and documents the status of the entire equipment.

### Operating experience

Since 2009 a MultipleDrive with three modules has been in operation on an MPS 4750 BC Pfeiffer mill at the Holcim cement plant in Grand Couronne, France. Each of the three modules is driven by Siemens motors 1LA4504-4CM00-Z with 1,450 kW. Load distribution and speed are controlled by Siemens Sinamics S120 frequency inverters. Grinding media at the plant is cement and granulated blast furnace slag. For a MVR 5600 C-4 cement mill at the Balaji plant in India, a 6,600 kW MultipleDrive was supplied with four modules. Each module provides 1,650 kW (Figure 3). ■

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## International Mining Award

# Recognition for gearless drive conveyor



The winning team, from left to right: Luis Galarza, Christian Dirscherl and Vincent Matthews, all from Siemens; Carly Lovejoy, Editor Mining Magazine; and Peter Sehl and Steve Kasper, both from ThyssenKrupp Robins

Every year the Mining Magazine bestows awards in twelve categories for innovation, machines and environmental cam-

paigns in the mining industry. This year in April, the Siemens Large Drives business unit and ThyssenKrupp were bestowed

with an award in the Bulk Handling category for their cooperative project on a gearless drive conveyor.

"The Mining Magazine Award provides impressive proof that we are a supplier of innovative drive solutions for the mining industry, and that this is recognized in the market," comments Christian Dirscherl from Siemens Large Drives. "Furthermore, this award clearly demonstrates that our cooperation with ThyssenKrupp in the field of conveyor systems is a great success."

The conveyor system is scheduled to enter operation in the third quarter of 2012 at the Peruvian Antapaccay mine, which belongs to Xstrata mining company. In the last years, the demand for gearless drive conveyors significantly increased worldwide. In addition to Antapaccay, Siemens won two other projects in South America. For these projects Siemens will supply the necessary 4 x 4,400 kW and 5 x 5,000 kW drive systems. ■

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## Coaltrans Asia

# Siemens presents material handling capability

Siemens participated at Coaltrans Asia at the beginning of June under the motto "Simine – solutions for your conveyor belt systems." Topics addressed at the stand included energy efficiency, reliability and sustainability of Siemens' solutions and systems for material handling. On a video screen at the stand, for example, visitors could learn more about Simine reference projects at the Los Pelambres mine in Chile and at Lumwana copper mine in Zambia.

Coaltrans Asia is touted as Asia's premier coal industry event, and it was held this year in Bali, Indonesia. The trade fair offered plenty of opportunities for networking and presentations from those at the forefront of the coal industry sector. ■



The topics addressed by Siemens at Coaltrans Asia included energy efficiency, reliability and sustainability

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Siemens staff from the various Siemens businesses associated with the cement industry

## Cementech India

# Green capability showcased in India

At the end of May Siemens made a strong showing at Green Cementech, an annual international conference and exposition organized by CII Sohrabji Godrej Green Business Centre in Hyderabad, India. Various business units at Siemens associated with the cement industry showcased their solutions in areas of green technology and operational excellence.

In the framework of the conference, Siemens representatives presented a paper on the latest developments in highly efficient drive systems, such as electrical motors and gearbox technologies. The Siemens exhibition stall was well visited by cement manufac-

turers, equipment manufacturers, consultants and industry experts. Again and again, visitors were impressed by the concept of a single-stop solution, from source to shaft.

The key objective of Green Cementech is to facilitate continuous performance improvement in Indian cement plants, with a primary focus on achieving world-class standards in regard to energy and the environment. More than 350 participants attended the event. ■

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## Expomin

# Largest mining event in Latin America

In mid-April, Siemens Drive Technologies presented its portfolio for the Latin American market at Expomin in Santiago de Chile. Expomin is one of the leading international trade fairs for the mining industry and Latin America's largest mining industry event. Exhibitors from all over the world included providers of technological solutions, capital goods, services and materials intended for the region's mines.

Visitors to the Siemens stand were presented with modern solution concepts for gearless drive systems as well as integrated automation systems for mines. ■



Exhibitions at the Siemens stand at Expomin focused on concepts for gearless drive systems

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If you are interested in receiving a sample copy, or if you would like to order a free subscription of MineralsFocus, please send an e-mail to [mining@siemens.com](mailto:mining@siemens.com).

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.

## Have a look at our new websites

"We create processes that take hold fast – with integrated solution modules to ensure smooth networking." This is the motto of the new website of the industry vertical cement. Here you will find a video about the biggest cement production line in Turkey, information about the Sicement product family, regional contacts, data sheets and brochures, etc.

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

In keeping with the slogan "Bringing out the best," the industrial vertical mining offers a comprehensive product, system and solution portfolio that covers extraction and transportation up to beneficiation and secondary processes. Information on gearless drives, videos on mining solutions and trade articles can be found at the relaunched website.

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



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