

metals & mining

The magazine for the metals and mining industries

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A person wearing a white hard hat and a blue jacket is seen from behind, sitting in a control room. They are operating a large piece of mining machinery, likely a conveyor belt or a bucket, which is suspended by cables and is dumping material into a large pile. The control room has a computer monitor on the left and a control panel with various buttons and lights on the right. The background shows a vast, open mining site with hills and a clear sky.

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Metals Technologies

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Bernd Zehntbauer

Dear Readers

According to current forecasts, worldwide demand for steel is predicted to grow by 25 percent by the year 2015. This expected growth will partly be met by newly installed plant capacity. The remaining demand is expected to be met by an increase of installed plant capacities as well as an increase of plant productivity. In order to face this challenge, steel producers focus more and more on efficient maintenance services and operational support utilizing synergy potential to a maximum in order to keep production costs at a minimum.

As the world's only full-liner in the metal and mining industry, Siemens VAI is your competent partner for the entire life cycle of your plant with innovative maintenance and service technologies.

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We combine more than 100 years of experience in plant construction with core competences in technology mechanics, electrics and automation. We build on thousands of service projects worldwide successfully concluded as a result of our knowledge of both global and local market structures: Out of a global network of 250 Siemens locations in about 190 countries, more than 40 are at your service with Metals and Mining know-how. Benefit from the many years of experience of 3000 specialists dedicated to Metals and Mining Services.

In this issue of **metals & mining** we focus on Services as part of the entire life cycle of plants in the mining, steel and aluminum industries. We convincingly demonstrate our innovation competence and also showcase our proven maintenance expertise with selected articles.

Enjoy reading the articles!

Bernd Zehntbauer
Head of XXXXXXXXX

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Second Corex Plant for Baosteel

Siemens VAI will supply another Corex C-3000 plant to the Chinese steel producer Shanghai Baosteel Pudong Iron and Steel Co. Ltd. (Pudong Steel). The contract was received within seven weeks following the successful start-up of the first Corex C-3000 plant. The new plant will also have a nominal production capacity of 1.5 million tons of hot metal per year and will be built next to the existing facility at Luojing in Shanghai. The Siemens project scope includes engineering, the supply of key process equipment and advisory services. ■

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Stronger Position

The Siemens Division Industry Solutions (IS) strengthens its position in metals technologies with the acquisition of Morgan Construction Co., Worcester, MA, USA, a designer and producer of high-quality rolling-mill products and services for the metals industry worldwide. In 2006, Morgan reported sales of 180 Mio USD and employed around 1,100 people in the USA, China, India, the United Kingdom, and in Brazil. Siemens intends to take over 100% of the Morgan Construction shares. The transaction is conditional upon the approval of the relevant authorities. Morgan Construction will be a division company of Siemens Industry Solutions under the responsibility of the IS Business Unit VAI Metals Technologies, headquartered in Linz/Austria. ■

Maintenance Services

For the first time in the world, Siemens VAI is to take over complete responsibility for electrical and mechanical maintenance of all the machinery and equipment involved in the steel production process – from the sinter plant and blast furnace to the steel works and slab caster. ThyssenKrupp CSA Companhia Siderúrgica entrusts Siemens VAI with the life cycle servicing of its new integrated iron and steel works in Brazil. Within the framework of this service contract, Siemens will set up two workshops at the site of the new integrated iron and steel works, employing around 600 people whose job it will be to maintain the new production facility. ■

New Main Drive for NSC

Siemens and its cooperation partner company, Fuji Electric Systems, have received an order to supply a new main drive for expansion of the heavy plate rolling mill of the Nippon Steel Corporation (NSC) in Oita. Commissioning is scheduled for March 2009. The heavy plate rolling mill of the NSC in Oita produces a maximum plate width of 5,500 millimeters and is one of the largest and most productive mills in the world.

Siemens is supplying a twin main drive with non-salient-pole synchronous motors. The drive has a speed of 40 rotations per minute and a rated power output of 8,000 kilowatts. Power will be supplied via Sinamics SM150 three-point DC link converters connected in parallel. Siemens will also be responsible for supervising installation and commissioning the drives. ■

Plant Start-ups and Acceptances (Sept. to Dec. 07)

Company	Country	Project
Adhunik Metaliks	India	FAC for 35-ton vacuum-degassing plant
Alchevsk Iron & Steel Works	Ukraine	Start-up of new Converter Plant No. 2, including primary and secondary dedusting system, FAC for 350-ton twin vacuum-degassing plant
Anshan Iron and Steel	China	Start-up (6th October) and Final Acceptance (19th December) for PLTCM No.5 (supply of Electric and Automation acc. Siroll CIS CM)
Azovstal Iron and Steel Works	Ukraine	Start-up of new twin ladle furnace and receipt of FAC
Baosteel	China	Start-up of Corex C-3000 plant; start-up of sublance, bottom stirring system and annular-gap scrubber for two converters
Caparo Merchant Bar	United Kingdom	Start-up of upgraded bar mill for largest merchant bar producer in the U.K.
Dansteel	Danmark	Revamp of AGC system for a Plate Mill
Deutsche Edelstahlwerke	Germany	FAC for process optimization of 6-strand billet caster and heat-pacing system for steelmaking and casting
Dneprovsky Iron & Steel Works	Ukraine	Start-up of auxiliary equipment and automation for Converter Nr. 2
Essar	India	Start-up of continuous operation in Tandem Cold Mill after major revamp including a new stand no. 5
Ferriere Valsabbia	Italy	Start-up of upgraded bar mill, including billet handling and hot charge system, upgrading and expansion of existing mill, and installation of new finishing train
Gerdau Acos Longos	Brazil	Start-up of annular-gap scrubber for converter
IPSCO	Canada	Start-up of upgraded EAF No. 4 and EAF No. 5
Isdemir	Turkey	FAC for Level 1 and Level 2 process automation for Blast Furnace No. 3
Jinan Iron & Steel Co.	China	FAC for 150-ton twin RH plant with T-COB (Technometal Combined Oxygen Blowing) lance
JSC Chusovoy Metalurgical Works	Russia	FAC for supply of finishing stands and auxiliary equipment for a bar mill
Lebedinsky GOK	Russia	Start-up of world's largest HBI plant (1.4 million t/a hot-briquetted iron)
Liepajas Metalurgs	Latvia	FAC for bar-handling upgrade equipment for bar counting, bundling, tying and weighing
Maanshan Iron and Steel Co.	China	FAC for 300-ton twin RH plant with T-COB lance, FAC for 300-ton twin-ladle furnace
Nizhny Tagil Iron & Steel Works	Russia	Total replacement and start-up of Converter No. 1 and off-gas treatment system
Panzhihua Iron & Steel Co.	China	FAC for Level 2 process automation, including expert system for Blast Furnace No. 1
Posco (Gwangyang Works)	Korea	Start-up of new dephosphorization converter, existing 2-strand slab caster replaced
Posco	South Korea	Start-up of new roughing stand R2 in Hot Strip Mill No.3 in Gwangwang
Qatar Steel	Qatar	PAC for new turnkey bar-rolling mill with annual capacity of 800,000 t/a
Rasselstein	Germany	Start-up of new coiler for Tandem Cold mill No.1
Riva Sellero	Italy	New vertical stand for rolling of large rounds in Siemens VAI-supplied finishing mill
Salzgitter Flachstahl	Germany	FAC for Dynacon process optimization system for three converters
Severstal	U.S.A.	Level 2 process automation, including expert system, for Blast Furnace C
Severstal North America	U.S.A.	Start-up of two upgraded stoves for Severstal "C" Blast Furnace Rebuild Project – awarded the ESWP (Engineers Society of Western Pennsylvania) Project of the Year for 2007
Shougang	China	Start-up (8th November) for new PLTCM with Electric and Automation acc. Siroll CIS CM
Stahl Gerlafingen	Switzerland	Start-up of upgraded shaft-type electric arc furnace
Steel Dynamics	U.S.A.	Upgraded beam-blank caster and extension to four strands
Tangshan Guofeng Iron and Steel Co.	China	Start-up of primary dedusting system for converter
Thainox	Thailand	Start-up of E&A for new Sendzimir Cold Mill
U.S. Steel	U.S.A.	Start-up of "A" Furnace Stove A1 at U.S. Steel Granite City Works after completion of reline
U.S. Steel Kosice	Slovakia	Start-up of annular-gap scrubber for converter



World mining market in transition

Demand Chasing Supply

Raw material prices worldwide have recently hit record highs, making the mining and excavation of minerals more economically attractive than ever before. Responding to this market situation, mining companies are now fighting to achieve dominant positions on individual continents. And, in the opinion of the author and many others, the struggle for increasingly scarce raw materials will only intensify in the coming decades.

The entry of densely-populated developing companies into the world economy has led to a structural change in the world markets for mineral raw materials. Above all, China's unrelenting hunger for raw materials has started to cause shortages elsewhere, bringing with it substantially higher prices.

As its economy continues to grow at around 10% per year, China is now consuming over 30% of the world

demand for raw steel and generating more than 20% of the demand for non-ferrous metals. Although the international market has been slow to react, a general tendency toward satisfying this long-term shift in demand has been recognizable since 2003.

Following a continual reduction in worldwide exploration outlays since 1997 to US\$ 1.9 billion in 2002, investments in new exploration have rebounded sharply

in the face of increasing raw material prices. At US\$ 7.1 billion in 2006, exploration investments grew to almost 50% in the non-energy sector over the 1997 level. One of the major players in mining, Brazil's CVRD will be investing US\$ 4.6 billion to increase iron ore production to 300 million tons in 2008. An even bigger effort is being made by BHP Biliton, the world's largest mining company, which has earmarked some US\$ 14 billion for the development of 23 projects currently in its pipeline.

Net exporters become net importers

The raw materials markets, particularly the metals market, are currently subject to very strong buyer demand, with supply bottlenecks resulting in record prices. In the last few years, China has become the world's largest consumer of steel and steel alloys in the non-ferrous sector. Despite expanding output capacities for zinc, for example, the country has ceased being a net exporter to become a net importer.

China has started securing its supply of raw materials by taking capital positions in mining projects worldwide. Besides China, growing economies to include India, Russia, and Brazil are moving forcefully into raw materials as well. This means that the market situation will remain tense at least over the middle term, despite the immense sums that will be invested in expanding output capacity over the coming years.

Significantly more expensive raw materials

Prices for many metals reached record levels in 2006 and 2007. One example is copper, which, at US\$ 8320/ton in 2007, was more expensive than ever before. Other metals have experienced similar price hikes.

China's hunger for raw materials is the major reason for these price increases. But, the rest of the world is also demanding more metals, fueled by international economic growth. Experts warn that the production output of most metals will be just enough to meet growing demand.

Although this demand will be primarily for gold, copper, zinc, lead and nickel, rarer materials, such as uranium, will also be needed to fuel many countries' growing reliance on nuclear power. Nevertheless, the supply of raw materials will not expand quickly, since it requires years until new deposits can be exploited efficiently and economically. In light of these facts, market observers believe that raw material prices will remain at a relatively high level for some time to come.

Mergers and acquisitions

Because of the current price situation, raw material producers are now enjoying revenue gains of more than 20%. The profits have fueled a host of mergers and

acquisitions, which have further consolidated the metals market.

Five international giants, including BHP Billiton, Rio Tinto, CVRD, Anglo American and Xstrata, have come to dominate the mining sector that has taken shape over the past few years. While the top 10 metal mining companies in 1995 controlled about 26% of the total value of all non-energy minerals produced globally, that share had risen to some 33% by 2006.

The need for technological renewal

Stilling the hunger for raw materials spotlights the need to develop new exploration methods and technologies, based on stronger investment in R&D. Even if exploration expenditures are included, R&D expenditure the metal mining industry is still very low compared with other industries. In the early 2000s, when metal prices were depressed, many mining companies slashed their R&D as well as exploration expenditure and handed over greater responsibility to equipment suppliers and junior exploration companies.

To make the discovery of deeper deposits more cost-effective, and to address pressing environmental and

Market observers believe that raw material prices will remain at a relatively high level



social concerns, the industry needs to invest more in R&D. The surge in the demand for metals as well as their growing use in developing countries will make it imperative to produce more metals while releasing fewer harmful emissions into the environment. It is not likely that these issues can be addressed adequately without more R&D – and soon. ■

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The robust mining market needs world-class solutions –
from Siemens

Rich Technological Claim

The international market for raw materials is characterized by strong demand and rising prices. New mines are coming on stream, but the companies operating them must pay strict attention to production costs, the environment, and efficiency in order to make – and keep – them economically viable. This is where Siemens decades of experience in mining comes in with solutions and technologies capable of delivering consistently solid performance.

COVER STORY >



Experts agree that 7–10 years of preparation are needed to make a new mine fully operational. This is the best case; most mining projects actually take much longer, as mine owners must contend with delays caused by environmental issues and the strict requirements of licensing authorities. Added to these delays, the mining industry, like the oil business, must deal with significant bottlenecks in equipment supply, with the delivery time for drilling equipment and crusher units taking more than 24 months in many instances. Mining engineers and experienced specialists are also at a premium.

Shortages of personnel and equipment, coupled with long preparation periods, drive up the costs of new mining projects. Opening a new gold mine in 2001, for example, cost an average of US\$ 150 million. Five years later, in 2006, opening a similar mine cost just under US\$ 350 million, according to the RMG. An exploding capital investment requirement like this is accelerating merger activity in the mining sector.

Daunting operational challenges

Genuinely daunting, the challenges for mine operators include the need to boost production, cut costs, and save energy – while ensuring maximum safety for per-



sonnel, machinery, materials, and the mine as well as conserving natural resources such as water and air.

“Environmental protection is gaining in importance every day,” explains Bernd Zehentbauer, head of the international mining business at Siemens. “Stricter mine operating requirements worldwide as well as the cost associated with their fulfillment have transformed environmental protection into a very significant expense.” Further cost factors, according to Zehentbauer, include the treatment and use of water as well as energy consumption. “Innovative and, above all, flexible technologies are needed here to reduce operational costs.”

Water of central importance

Open-cast mines need up to 70,000 m³ of water each day to maintain production. That corresponds to the water requirement of a large city. Up to eight tons (8 m³) of water is used to wash each ton of ore. Although

COVER STORY >



Open-cast mines need up to 70,000 m³ of water each day to maintain production

water consumption in the open-cast mining has decreased by some 60% since 1990, productivity gains have actually caused the situation to deteriorate. In Latin America, in particular, many open-cast mines can no longer operate at full capacity, due to a lack of fresh water to process the ore. The importance of water in mining cannot be overstated. "Because only 1% of the world's water is suitable for drinking, it is our responsibility to utilize this resource as efficiently as possible," notes Zehentbauer.

In mining, water resources include surface water from rivers and wells, desalination of seawater, or the reuse of mining water from the tailing dam. Nevertheless, diminishing wells and restricted water rights are forcing the mining industry to develop additional water resources as fast as possible.

In view of increasing water scarcity and stricter environmental regulations, efficient preparation of process water – and the reduced use of fresh water – has long been key to effective mining operations. Siemens offers proven solutions for water treatment in mines. All water treatment processes and equipment are part of the Siemens Water Technology portfolio of products and solutions. "Only the most reliable and robust technologies have been chosen to become mem-

bers of the Simine^{CIS} Water Product portfolio," Zehentbauer emphasizes.

Under the Siemens Simine^{CIS} concept for mining, water treatment operations are combined with automation systems so the customers can concentrate on their core business of mining, while Siemens operates the primary and secondary processes aimed at minimizing the operational costs and meeting environmental standards. Zehentbauer further notes that "key areas of water processing in mining operations are process water preparation, flotation process water recovery, and leaching processes."

More often than ever before, water shortages are jeopardizing the productivity of open-cast mines. Additionally, Zehentbauer explains, "much of the waste water in mines is contaminated with heavy metals, arsenic, chlorides, and sulfates and can no longer be used for production. Adding to the challenge, ever tighter environmental regulations forbid the discharge of waste water into the surrounding environment."

Siemens provides water treatment systems that are geared to the pollutant mix at the open-cast mine; they remove pollutants from the water cycle and return fresh water to be reused in production. This enables open-cast mining operations to expand their capacity while reducing the burden on the environment.

Innovative partnership with Freiburg Polytechnic University

Siemens is currently cooperating extensively with Freiburg Polytechnic University in Germany to develop innovative water technologies. Both partners are benefiting from the results of research and practical implementation, particularly in the development of new process technologies in the mining industry. One especially promising development involves the use of membrane technology for the treatment of acid mine drainage (AMD), which, according to Prof Bernd Haertel of the Department of Thermal and Environmental Process Technology at the university, is an ecological and economical alternative to traditional tailings treatment that requires enormous use of expensive chemicals.

Siemens contribution to ARD/AMD

For the treatment of water that has been contaminated with heavy metals and sulfates, the Siemens ARD/AMD (Acid Rock Drainage / Acid Mine Drainage) system combines conventional chemical treatment processes with membrane technology. The chemical step removes suspended particulate matter, and the membranes remove the toxic substances. This combination technique cuts the amount of sludge residue and employs lower quantities of chemicals than tradi- >>



Bernd Zehentbauer, head of the international mining business at Siemens.

"The goal, quite simply, is to increase the productivity of mine operators to help them cope with the growing demand for raw materials in the steel industry worldwide"

>> tional systems, which saves money and ensures conformity to strict environmental regulations.

Treatment of the water from the tailings pond is accomplished by membrane technology, which removes 99% of the toxic substances. Residual particulate matter is then removed in the filter bed. No additional chemicals are required, and the filter system cleans itself at regular intervals.

“Today, up to 80% of the treated water from the flotation and the holding ponds can be returned to the process,” notes Zehentbauer. The system’s modular design ensures that solutions can be provided for all types of open-cast mines requiring treatment of relatively small to very large volumes of water.

In addition to water treatment technology, Siemens is working with Freiburg Polytechnic on the further development of solutions for saving energy in mining operations. Another area is process optimization directed at better occupational safety using automation and MES.

Making MES matter

For open-cast mining operations, Siemens has developed the Simine MES (Manufacturing Execution System) library. Besides interfaces to production processes

and equipment, this package provides new standard functions, which supply management with real time information along the entire mining value chain.

The Simine MES library visualizes production processes from excavation and transport through crushing to secondary processes, such as water treatment, or storage. Information is conditioned according to the needs of the individual user. Based on integrated Simatic IT components, which have been expanded to include special MES functions for mining, the library enables the unambiguous representation of different process steps.

The Product Tracking & Tracing component, for example, monitors the mined material from excavation through transport and beneficiation to the storage bunker or loading onto a train or ship. A production benchmark is created using key performance indicators (KPIs) based on individual evaluation of equipment availability, utilization, safety, environmental faults, and maintenance records of the different production lines. The KPIs give mine operators the information needed to analyze the real time improvement needs of their equipment, to determine the action to be taken, and to check whether the action has actually taken effect.

Benefits of Turning to SIMINE^{CIS}

Complete system solutions for the entire mining value chain from excavation to beneficiation

End-to-end, turnkey solution packages from a single source

Solutions that pay for themselves over the life cycle of the mining operation

Maximum equipment availability and operational flexibility

Technical innovations for greater energy efficiency, higher productivity, and enhanced environmental compatibility.





Operational flexibility, equipment mobility

Another enhancement of mine productivity involves the equipment flexibility, which Zehentbauer defines as “equipment that is mobile enough to enable its transfer to any location in the mine with relative ease.” To this end, Zehentbauer notes, Siemens has developed a concept for concentrator equipment that includes containerized substations.

“Although a mine can typically be exploited for 30 to 100 years, depending on the richness of the deposit, it is rarely clear in the beginning where to put the equipment or where the equipment will need to go next,” adds Zehentbauer. “This underscores the need for flexible and mobile solutions, in ore concentration, in water treatment, and elsewhere.”

Tailormade, comprehensive service plans

Even though maintenance accounts for as much as 40 % of mine operating costs, it is the only alternative to un-

planned downtime. Siemens offers a comprehensive plan covering consulting and implementation, technical support, the assumption of maintenance processes, and plant optimization packages.

Service contract options range from simple on-call service to the assumption of operator risks. The aim of all contracts is to work in close cooperation with the customer to achieve a competitive edge together. Specialists at the Siemens Support Centers are available around the clock to provide everything from technical support over the telephone to onsite equipment maintenance by teams of highly-qualified engineers and technicians who are available on short notice.

A further component of the service contract can be online data acquisition, processing, and analysis. This enables a detailed diagnosis of the actual conditions of the components monitored and a sound assessment of improvement potential.

In the future, Siemens will strengthen its services spectrum to include modernization and retrofitting. “The goal, quite simply, is to increase the productivity of mine operators to help them cope with the growing demand for raw materials in the steel industry worldwide,” concludes Richard Pfeiffer, head of the Metals Technologies division at Siemens.

Completely Integrated Solutions for the mining industry

Siemens solutions optimize basic and important plant parameters, helping to organize them into a comprehensive, yet efficient solution. That’s the idea behind Completely Integrated Solutions, which entail providing an optimized solution for every plant with best-in-class products that are standardized to keep their manufacturing costs as low as possible and linked onsite to handle advanced applications.

All these products and performance modules fit seamlessly together to cover the excavation, transport, and beneficiation of raw materials. The Simine^{CIS} DISCONT (for discontinuous mining); Simine^{CIS} CONT (for continuous mining); and Simine^{CIS} Winder (for the mine winders) solution packages cover both primary and secondary processes. Their modular components are designed especially for mining, each providing the right technological, electrical, automation, and IT solution for every customer need. ■



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New drive systems for Draglines

Gearlessly into the Mine

Until now, draglines all over the world were outfitted with geared DC drive systems motors only. Siemens and Bucyrus have jointly developed a gearless AC drive system – Simine^{CIS} DRAG. One of the first systems to be employed is in the Chinese Zhungeer coalmine. Excavators already in use can be retrofitted.

The 13,000 HP drive systems with a performance of 9,7 Megawatt are used for Hoist and Drag motion of the dragline. By eliminating the gears, the cost for maintenance and operation are reduced in comparison to conventional drives. The extended service intervals reduce maintenance and increase the excavator's availability. Gearless AC drive systems also offer up to 20% more efficiency and use less energy, thus reducing operating costs.

Simine^{CIS} DRAG combines reliable electronics and controls proven in thousands of Siemens powered locomotives and mining shovels, with gearless ring motors which have been in reliable service in grinding mills, mine winders, chain excavators and conveyors for more than 25 years. Siemens combined these proven, reliable components into a new, revolutionary Dragline drive system.

A new drive in coal mining

Siemens is currently outfitting the first Bucyrus 8750 excavator with the new drive system for use in the Chinese Zhungeer coal mine, 120 km south of Hohhot, the capital of the Nei Monggol province (Inner Mongolia). The mine is operated by the state-owned Shenhua Group Corp. based in Beijing. In the Nei Monggol province, coal has been strip mined for some time. The city of Zhungeer is to become China's energy center with currently 4 coal-fired power plant in operation and one or two more planned.

The dragline's ring motors are outfitted with 9 winding systems. The ring motors were delivered in two halves and had to be assembled on site. The assembly

was especially difficult as 90 percent of the work had to be done outdoors. The roof was added later and all hoisting jobs had to be carried out by mobile crane. Bad weather conditions and coal dust from the mine close by further impaired the work. Sandstorms appeared almost every day and heavy winds made assembling the poles difficult. "Testing was done under sometimes extreme conditions. Aside from some starting problems, the unit has proved very successful. A top result for a new technology!" describes project director Ralf Lechtenfeld.

The drives are controlled by AC IGBT inverters supplied and installed by Siemens Energy & Automation in Atlanta. The excavator is in operation since December 2007.

Seamless integration of Siras and Midas

To achieve high uptime and short MTTR (Mean Time To Repair), Siemens offers the most advanced and user friendly maintenance computer in the industry. It shows the mine electrician where the problem is, and which part is needed to fix it.

The dragline system also seamlessly integrates with Siras and Midas. Siras remote diagnostics uses Internet technology to "keep the factory on the machine". Siemens service technicians and other experts can log on from around the world and can do the same work as the electrician on board of the dragline with the exception of tightening a screw. Midas harvests a wealth of data during normal operation and makes it available for productivity analysis and optimization. ■

Main Benefits

- Higher machine productivity
- Higher drive system efficiency
- Less maintenance
- Lower life cycle operating costs
- Seamless integration of Siras and Midas

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The Bucyrus excavator with the new drive system for use in the Chinese Zhungeer coal mine



Gearless drives for the dragline



Market leader for 40-ft. gearless drives for grinding mills

Pole Position

Mills in ore preparation and beneficiation must be able to adapt to a wide range of material properties. Minimization of wear, service and unscheduled downtimes are further key requirements. Siemens sets the industry standard in this field with gearless drives that run virtually wear-free. For 40-ft. SAG mills Siemens takes over the pole position in the global market.

A patented transvector controller allows precise adaptation to every requirement – even extremely low speeds for revision. Long service intervals and drastically reduced downtimes mean increased productivity. Around the world, Simine^{CIS} Mill GD (gearless drives) is contributing to significantly higher productivity in dozens of installations with major mining players. The drive principle Simine^{CIS} Mill GD without moving parts between the motor and the mill gives the machine the required degree of robustness. Variable-speed operation and patented Transvek-tor control also ensure that the operating point of the motor can be exactly adjusted to changing requirements – for processing different material hardnesses or for running in different modes. This ensures a convenient positioning also in inspection modes at very low speeds, such as inching or creeping.

Major orders give proof of pole position

In the last months Siemens has received three orders to supply gearless drive systems for grinding mills. From the CITIC Heavy Machinery, Luoyang, Siemens has received an order to supply gearless drive systems for five 40-foot autogenous grinding mills. The systems each have an output of 28 MW and are therefore the most powerful mill drives that are commercially available. The AG mills are intended for use in Australia in

“Sino Iron”, one of the largest open-cast iron-ore mining projects in the world. The ore mills are scheduled to start operating successively in the course of 2009. The five 40-foot AG (autogenous grinding) mills will be used for grinding the ore. Ren Qinxin, General Manager of Citic Heavy Machinery commented: „This is a landmark project for both our companies. It is the biggest order for ore mills ever placed in the mining industry. With Siemens, we have a good cooperation history and a deep relationship. We are confident together we will be able to successfully implement this outstanding project.”

Also Anglo American Chile ordered a 22 MW gearless drive for a 40’ SAG-mill and two 16.4 MW gearless drives for two 26’ ball mills for their Los Bronces Development Project. Anglo American Chile is a subsidiary of the London-based Anglo American PLC, and operates four mining sites and a smelter plant in Chile. Furthermore, the company is one of the major owners of the Collahuasi mining company. In 2006, Los Bronces, located about 65 km east of Santiago, produced approx. 226,000 metric tons of copper as well as molybdenum. Thanks to this development project production is foreseen to be expanded by 170,000 metric tons on average as from 2011, making Los Bronces one of the biggest copper and molybdenum mines worldwide.



10 years of experience: 40' SAG-mill at Cadia Valley Operations equipped with Siemens technology



Frozen Charge Shaker

Anglo American decided to exclusively install gearless driven mills in this plant to avoid time consuming maintenance and power losses due to girth gear and pinions. The gearless drives solutions developed by Siemens are designed to provide mill drives with the lowest possible power consumption available in the market while offering highest availability and reliability. Result of the design shall be mill drives with the lowest life-cycle cost and highest production figures. All three gearless drives will be equipped with a “Frozen Charge Shaker”, a system recently developed by Siemens allowing for controlled release of frozen charges. This removes the need for manual cleaning and thereby reduces downtime. A PC-based diagnostic and information system with server-based documentation system will enable an easy access to all maintenance documentation.

Gearless mill drives for mine in Venezuela

Further Siemens has received an order from Compañia Aurifera Brisas del Cuyuni C.A., Venezuela, a subsidiary of Gold Reserve Inc. located in Spokane, Washington, USA, to supply two gearless mill drives for an open-cast mining operation. The purpose of these drives is to improve the efficiency of grinding copper ore. Siemens is supplying two gearless mill drives for

two 11 meter high SAG mills, each with an output of 20,000 kilowatts at a speed of 9.26 rpm. The purpose of these is to ensure more effective grinding of the copper ore. The speed of the drives is variable, which allows different operating modes to be implemented, such as soft starting and stopping. As a result it is also possible to adapt the speed to suit the varying requirements of the material being ground. As the drives have no need for a clutch or gearbox, there is less maintenance involved and downtimes are shorter. Higher efficiency compared with conventional drives reduces energy consumption and saves costs.

The drives are controlled and monitored with the aid of an HMI (Human Machine Interface) that makes it simple for the operator to deal with all mill operations. The mills can be controlled either locally or from the central control room. Local inspection for maintenance work can be carried out with a manual control console, for example. ■

Main Benefit

- Controlled acceleration, deceleration and stopping of mill
- Precise and fast positioning in inching and creeping mode
- No downtimes due to lack of girth gear/pinion maintenance

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Completely integrated solutions deliver greater efficiency

In Focus: Mine Automation

Simine^{CIS} integrated mining solutions include the control, monitoring, display, and optimization of mining production from excavation through transport to processing and secondary processes to include water treatment or storage. With Simine^{CIS} CC (Control Center) and Simine^{CIS} MES (Manufacturing Execution System), Siemens has developed solutions whose modular design, technical consistency, and specific mining features combine to provide a virtually unlimited number of way to adapt mining control technology to individual processes and requirements.

Simine^{CIS} CC is based on the Siemens Simatic PCS7 production standard. Thanks to years of experience in both process and discrete control, Siemens has been able to put the Simine^{CIS} CC mining automation solution onto a single in-house platform. As an end-to-end automation solution, it includes automation, communication, and data management covering extraction, transport, processing, and distribution of the mined raw materials.

Standard Simatic PCS 7 features

The unique scalable architecture of Simatic PCS7 enables the same components to run from 100 I/O points in single machines up to huge applications with 100,000 I/O points. The open, integrated communication for the automation throughout the entire enterprise is a basic requirement that allows all units of the plant to interact based on industry standards such as Industrial Ethernet with components supporting 10/100 Mbit/s or 1000Mbit/s technology and Profibus, the Siemens fieldbus standard based on electrical or optical transmission technology. The wide range of intelligent field devices using industrial standards such as Profibus, Foundation Fieldbus, and HART means more decentralization in the field, which speeds the execution of applications and reduces processing costs over the entire life cycle of the plant.

With regard to user-machine interaction, the flexible Simatic PCS7 operator system can be customized to various plant sizes, process cases and customer requirements. Multi-user systems with up to 12 servers or 12 redundant pairs of servers are supported. In mul-

ti-client mode, OS clients can access data from one or more of the 12 servers/pairs of servers in parallel. The Simatic PCS7 web server based on Microsoft Windows supports remote operation and monitoring over the intranet/internet.

For its part, the Simatic PCS7 Maintenance Station supports plant asset management, including the administration and management of plant equipment, particularly I&C equipment, as well as all activities to retain or enhance the value of a plant.

Production management

Simine^{CIS} MES is the Siemens response to the growing demands being made on production management systems for the mining industry. Advantages lie not only in the improved production planning capability, but in the consistent display of information across all processes.

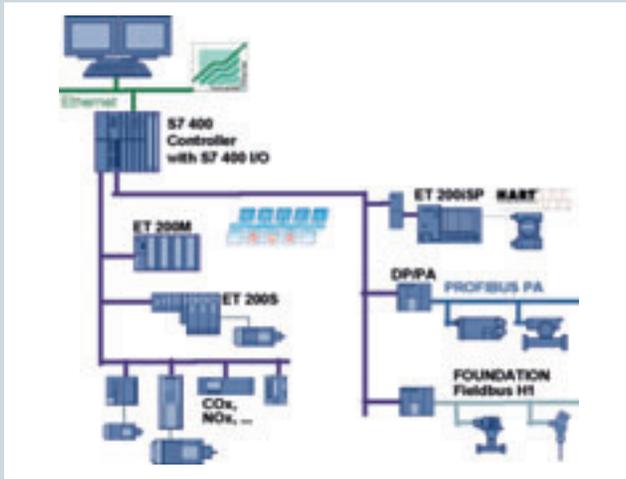
As an online system, Simine^{CIS} MES also closes the gap between the real time automation process and transaction-oriented ERP. That enables management to make decisions based on real time information, which enhances productivity and improves process availability.

Based on Simatic IT, Simine^{CIS} MES includes packages for:

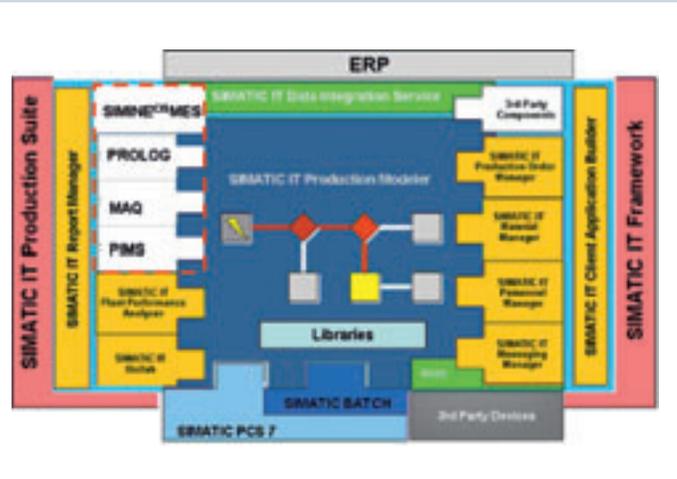
- Production planning / supervision: PROLOG Library for production modeling, scheduling, order management
- Material management: MAQ Library for stock management, blending, material tracking
- Process information management: PIMS Library for KPI, OEE, reporting.



XXXXXXXXXX



Highest degree of integration - Simine^{CIS} CC solutions



Simatic IT Production Suite

Unique Simatic IT performance

Siemens was one of the first to understand the challenges of MES in mining. Simatic IT provides a sophisticated framework environment that enables the modeling of the production processes and operation procedures, synchronizing and coordinating the functions provided by the individual components.

The basic design approach, revolving around a production modeller and components, offer the unique possibility to build flexible and tailored solutions based on standards. Solutions build with the Simatic IT framework standardize operations at a high level while maintaining flexibility at the operational level. The modeling approach keeps end users solutions easy to maintain and modify while the open architecture supports the interfacing of higher and lower level computer systems as well as integration of third party software modules. The figure above shows how Simine^{CIS} components plug directly into the Simatic IT frame-

work. Industry/sector specific libraries represent Siemens solutions for the mining industry based on standard cross industry products.

The right solution for mining operations

With its unique concept of Simine^{CIS} based on the components of TIA (Totally Integrated Automation) Siemens approach to automation stands for consistent and scalable performance from the shop floor to the management level. Combining mining expertise with the Simine^{CIS} CC und Simine^{CIS} MES components has put Siemens in a excellent position to adapt TIA systems and technology to the most diverse needs of the mining industry worldwide. ■

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Modernization of the coke-oven by-product plant at Isdemir, Turkey

An Optimized “Buy-Product” Plant

IRON & STEEL >

To cope with the increased gas quantities to be generated from two new coke oven batteries at the Turkish steel works of Isdemir, the existing coke-oven by-product plant was completely modernized by Siemens VAI, Finland. The project scope included the engineering and supply of mechanical equipment, instrumentation, electrics and automation as well as the supervision of construction and commissioning. In February 2008, the modernized coke-oven by-product plant was successfully commissioned. The gas-treatment capacity was doubled, complete process monitoring and control is now available from the central control pulpit and reliable product-quality assurance is provided.



Figure 1: Crystallization Stations No. 1 and No. 2 for recovery of ammonium sulfate. Figure 2: Tar separators for removal of swim tar. Figure 3: Tar decanters

As part of a campaign to increase the annual production of steel to approximately 6.25 million tons by the end of 2009, the Turkish producer Isdemir, located in Iskenderun (Hatay Province) on the Mediterranean coast, is modernizing and expanding its production facilities. In order to meet the increased coke demands of a new blast furnace currently under construction, the coke output from the company's cok-

ing plant will be increased from 1.2 million tons per year to 2.4 million tons per year through the installation of two additional batteries (No. 5 and No. 6). This necessitated an expansion and modernization of the existing coke-oven by-product plant, which now comprises two semi-separate gas-treatment lines capable of processing 140,000 Nm³/h of coke-oven gas from all the six batteries.

Mechanical equipment supply

From the process point of view Siemens VAI, Finland was responsible for a wide range of mechanical equipment and upgrading activities. The existing ten primary coolers of the *primary gas-cooling system* were retubed and sand blasted. Two new primary coolers were added. Eight *tar precipitators* were completely rebuilt, using only the shells of the existing units. The entire *gas exhaust system* was overhauled to satisfy the new process demands. The *ammonium sulfate production and drying section* (Figures 1 and 2) was completely demolished and reconstructed as two production lines comprising three new ammonia absorbers and two independent crystallizing lines. The slurry from this section is fed to the new centrifuges from where the partially dried salt is transferred to a newly built dryer. Four *final coolers* were rebuilt. Each cooler is equipped with a recycle cooling line comprising three heat exchangers – two are in operation and one serves as a spare. Efficient direct final cooling is now provided. Two final coolers will remain in standby operation. The three serial *crude benzene scrubbers* in each of the two independent production lines were refurbished to increase capacity. All scrubbers will be in operation. The existing *crude benzene recovery line* had been idled for some time. It was completely rebuilt and is now comprised of a wash oil cooler, heat plate exchanger, dephlegmator, benzene condenser, benzene separator and phlegma separator, etc. Apart from the existing four decanters, two new high-efficiency *flushing liquor and tar decanters* (Figure 3) were installed to satisfy the new process demands. Two ammonia liquor pumps and a flushing liquor strainer, etc. were also added.

The *ammonia liquor distillation section* was rebuilt to enable settling and stripping of ammonia to boost ammonium sulfate production and to satisfy strict environmental regulations. The two existing *cooling tower lines* comprising ten towers for primary cooling were refurbished and two new cells with filtration and chemical-dosing systems were added. The existing *cooling towers for final cooling* were demolished and rebuilt with filtration and chemical-dosing systems. A completely new *foul-water system* was built. The existing *biological effluent-treatment line* was completely >>



Figure 4: Control pulpit of coke-oven by-product plant

- >> overhauled to comply with stricter environmental regulations.

Instrumentation, electrics and automation

The Siemens VAI scope of supply also included instrumentation, electrics and automation (Figure 4). *Field instrumentation* is IP-65 compliant (Ingress Protection against dust and water). Robust and safe instruments are installed in hazardous plant areas. The installed *electrical equipment* meets strict international standards and is based on intelligent control principles. All LCPs (Local Control Panel) satisfy IP-65 standards. The MCCs (Motor Control Centers) were replaced and equipped with intelligent and reliable Simcode DP control (Siemens *Motor Protection and Control Device – Decentralized Peripherals*). In some cases variable frequency drives were also used.

Both *Level 1 and Level 2 automation systems* were supplied. Level 1 systems feature the fully redundant Simatic PCS7 DCS system which has redundancy built into both its controller and operation software, ensuring that the plant has near-zero downtime. The DCS (Distribution Control System) assures easy monitoring and control of various process devices (field instruments, motors, valves, etc.) throughout the plant. The operation software is designed and developed to enable early detection of process or equipment problems. Process-specific alarms allow the operators to take quick action when required. The Level 2 system is based on the Windows Server 2003 platform. It is equipped

Coke-oven by-product plant

In the cokemaking process high-grade coals which satisfy a strict set of physical and chemical criteria are converted into coke for use in a blast furnace by heating the coal in sealed chambers at temperatures in the range of approximately 1,100 °C for 14 to 36 hours in the absence of oxygen. Volatile substances are released from the coal and exit the coking chambers in the form of a hot, raw coke-oven gas. The gas is cooled and cleaned in a by-product plant so that it can be used as a fuel gas for heating purposes (e.g., to heat the coke-oven batteries) or for power generation, etc. In a series of treatment steps water vapor and contaminants are removed and various chemical compounds and substances are extracted from the gas which can be sold for use in the chemical and agricultural industries. These include tars, ammonia/ammonium sulfate, naphthalene, BTX, hydrogen sulfide and sulfur/sulfuric acids.

with a historian analysis system to support process performance investigations. It also has an interface to the laboratory, supports SPC analyses (statistical process control) and generates reports.

Results and benefits

Following the completion of this project, a number of major improvements were achieved at the coke-oven by-product plant of Isdemir. The coke-oven gas-treatment capacity was increased from approximately 70,000 Nm³/h to 140,000 Nm³/h. Plant operations and monitoring have become far more easier since all the process information is now readily available in the central control room. Maintenance engineers can quickly detect and rectify any problems which may arise in connection with the field devices. Precise monitoring and process control ensures that the plant achieves highest efficiency with respect to the removal of ammonia, BTX (benzene, toluene and xylene) and tar, etc. from the coke-oven gas. Isdemir is now capable of profitably selling approximately 40,000 tons t/a of ammonium sulfate, 75,000 t/a of tar and 30,000 t/a of benzol – the main by-products from the coke-oven gas – to the chemical industry. ■

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Sinter VAiron – Integrated optimization of ore preparation and sintering

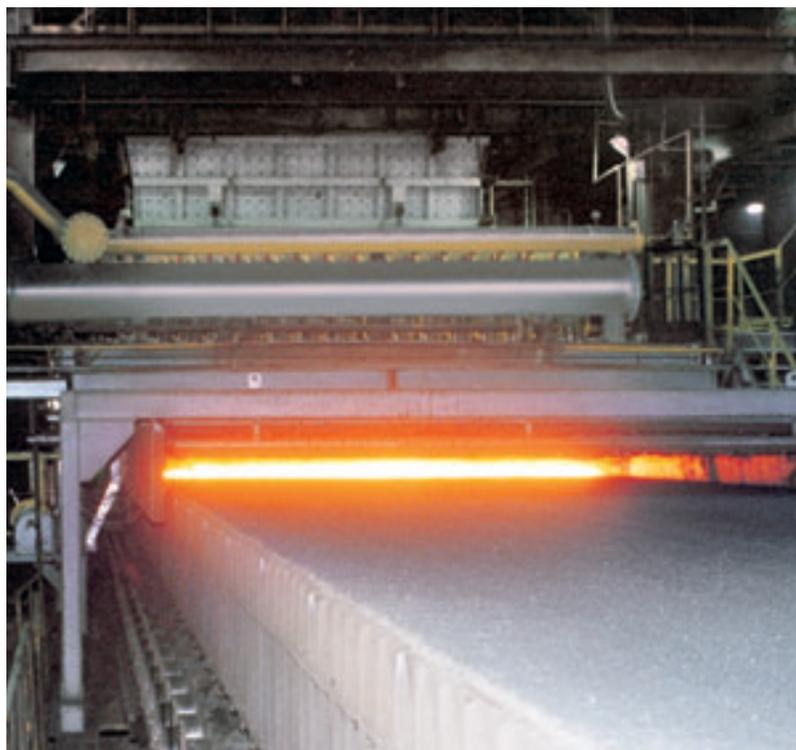
Get More From Your Ore

Sinter VAiron is an advanced process-optimization system developed by Siemens VAI and the Austrian steel producer voestalpine which extends from ore preparation in the blending yards, covers the production of sinter feed in the sinter plant, and takes into consideration the requirements of the blast furnace. The main overall target of the system is to achieve a high output of uniform sinter quality at low operational costs. This is accomplished by the application of a number of sophisticated tracking, diagnosis and control models and systems which are bundled within an overall expert system.

In the sintering process, the sinter product must satisfy defined target values with respect to chemical and physical parameters for use in the blast furnace. Sinter quality begins with the proper selection and mixing of the raw materials in the blending yard and sinter plant. The chemical properties are stabilized by an automatic adaptation of the raw material mix. An enhanced burn-through-point-control system which takes into account physical and chemical properties of the sinter mix is incorporated in Sinter VAiron. A key feature of the system is its capability to quickly react to process fluctuations and aberrant situations, such as an inhomogeneous mixture, poor surface ignition or incomplete burn-through of mix. This is achieved in closed-loop process control, resulting in smooth sintering operations and uniform product quality.

System structure and technological controls

Sinter VAiron is characterized by a modular system structure (Figure 1). In addition to basic functions such as data acquisition and setpoint execution, technological controls (main control loops) are implemented in the basis automation system. These include raw-mix-ratio control, raw-mix-feed control, moisture control,



Ignition hood of sinter strand, voestalpine Stahl, Austria

surge-hopper-level control, drum-feeder control, ignition-hood control, exhaust-gas-cooler control and cooler control. The focus of these basic control functions is to assure reliable sintering operations and also to enable continuous process optimization.

Process information and data-management system

The data acquisition function preprocesses and stores the data from a broad spectrum of raw data sources, including front-end signals, material weights, laboratory data, events, model results and cost data, etc. Sinter VAiron interprets process data, performs model calculations and visualizes the results in Windows- or web-based graphical user interfaces. Data handling encompasses the chemical and physical data of the sinter strand as well as the process history. The raw sinter mix and the production process are monitored in detail >>

- >> from ore preparation to the blast furnace. Unfavorable conditions can be detected and eliminated.

Process models

As outlined in the following, a number of process models are available in the Sinter VAiron automation package. Approximately 700 different model values are considered in the calculations.

In combination with the expert system, the *raw-mix calculation model* is one of the unique highlights of the Sinter VAiron automation solution. It is a central part of closed-loop raw-mix preparation, and ensures that the required raw mix is produced to achieve the target material properties and planned sinter production. In order to modify the charging set points, the coke addition, sinter basicity, raw material analyses and their influence on sinter parameters are taken into consideration. The *stacking plan tool* calculates a stacking plan for the blending of ore beds on the basis of the results of the corresponding raw-mix calculation. The *blending ore bed-distribution model* simulates the 3-D geometry and spatial distribution of analysis data of the blending beds by calculating the volume of the material mixture per stacking step (Figure 2). The model provides the chemical analysis distribution for any position within the blending yard.

Sinter process supervision models calculate the raw mix permeability, moisture content of the raw mix, the average particle size of the raw materials, the harmonic diameter of the sinter product and the burn-through-point position – decisive for the control of the sinter strand velocity and productivity. The *sintering process model* determines the position of the burn-through point (BTP) which is indicated by the set of the exhaust-gas temperatures received from thermocouples installed in the last suction boxes of the sinter strand.

With careful control of the sinter-strand speed and an ideal positioning of the BTP close to the end of the strand, productivity can be maximized. The sintering process model predicts the burn-through time (BTT) as an indicator for the dynamic behavior of sintering, based on process conditions and raw mix parameters, e.g., the material permeability. The compiled predictions of the BTT for discrete sinter-strand segments is one of the important starting points for the calculation of the optimum sinter-strand speed by the expert system.

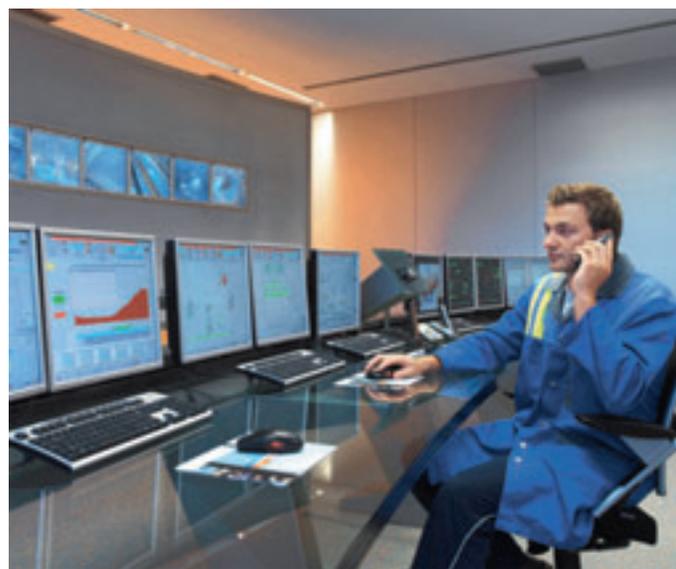
The gas flow through the sinter strand is a function of the permeability of the raw mix. As the total sintering time depends on the total gas flow, a higher permeability obviously leads to shorter burn-through times. However, a higher gas flow in one section of the sinter strand will result in a reduced gas flow in other zones along the sinter strand. Therefore, this model in-

cludes a permeability-based simulation of the sintering process for improved sinter-process control and higher productivity.

Sinter VAiron expert system

The basic structure of the expert system is shown in Figure 3. The diagnostic system, which is based on historical data, auxiliary calculations and actual measuring values, diagnoses the overall sinter-plant status and previous sintering conditions. Input data is checked for plausibility or compared to admissible limits in order to avoid erroneous diagnoses.

One of the major tasks of the expert system is the calculation of parameters such as the production level, fuel consumption, chemical quality, physical quality and other key-performance indicators. Another major function of the Sinter VAiron expert system is to provide corrective actions by suggesting the modification of process variables. These include the quantity of sinter return fines, coke additions, productivity control, basicity of the sinter product, coke base in the raw sinter mix, the SO₂ content in the waste gas and the FeO content of the produced sinter. Each particular corrective action can be executed in closed-loop operation or in semi-automatic operation. In closed-loop operation the calculated set-points determined by the expert sys-



Control pulpit of sinter plant, voestalpine Stahl, Austria

tem are automatically transferred to the process-control system whenever a set-point change occurs due to changing process conditions. The system performs all recommendations simultaneously and does not require any interaction by the operators. In semi-automatic operation the calculated set-points determined by the expert system are presented to the operator on

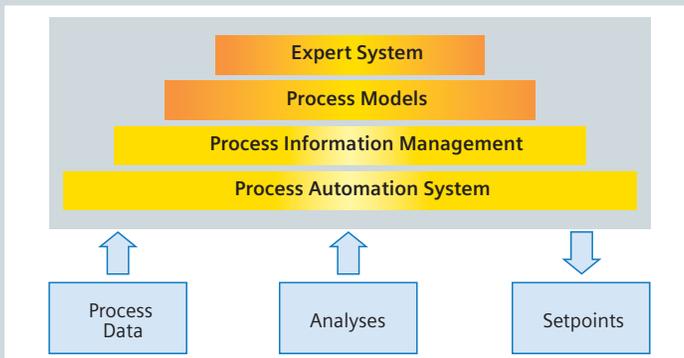


Figure 1: System structure

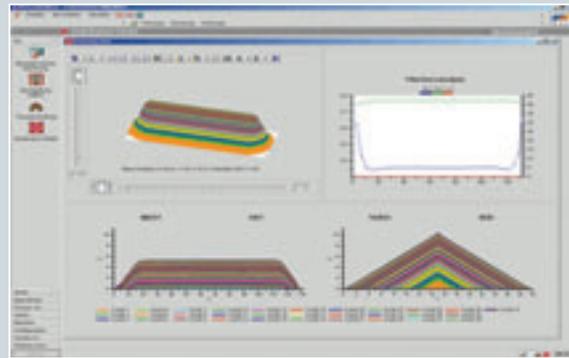


Figure 2: Visualization of ore blending bed distribution model

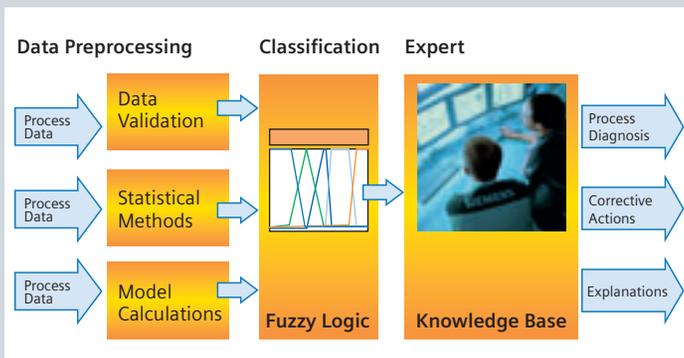


Figure 3: Structure of VAiron expert system

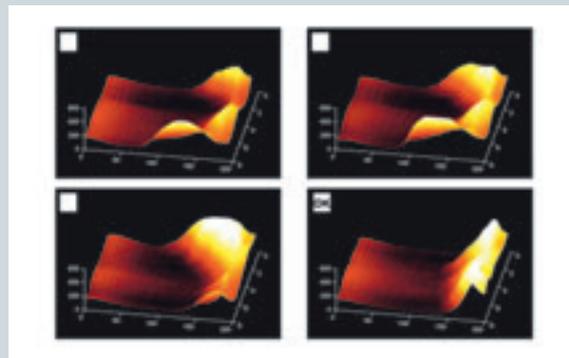


Figure 4: Transverse burn-through point control

the HMI (human-machine interface) of the process-optimization system. Within a certain time period, the operator has the possibility to acknowledge, change or refuse the recommendations.

There are many indicators assisting the strand-speed control, decisive for productivity. Some of these are available at an early stage in the process (e.g., the permeability), others only in hindsight (e.g., the harmonic diameter). Generally, the information attained at a later stage is more precise than that attained early on. The fundamental idea was therefore to use the early information to control the processes and to use the information attained at a later stage to self-tune the control system. With these two independent sources of information it is possible to achieve high control accuracy, despite fast corrective actions. Since the availability and reliability of the data differs from plant to plant, the expert system can be based on individually selected entry data at the respective plant.

Full utilization of the strand surface can only be reached when the flame front also reaches the lowest layer across the entire width of the strand simultaneously. This is obtained through the transverse burn-through point control (Figure 4). Feedback on the burn-through point is derived from the temperature conditions in a transverse direction in the last suction

boxes. Necessary corrective measures are then executed online, allowing a uniform flame front to be achieved.

Industrial application

Sinter VAiron was implemented at the integrated Austrian steel producer voestalpine in mid-2007 in a joint project between Siemens VAI and voestalpine. The system provides a fully integrated approach to ore preparation and sintering operations, taking into consideration the requirements of the blast furnace. The application of the closed-loop expert system allows transparent and reliable process control in addition to the shift-independent production of sinter at a high quality and productivity level. Sinter VAiron is an important milestone in the fulfillment of the vision of “fully automatic iron-making operation.” ■

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Start-up of the No. 3 blast furnace of Arcelor Mittal Tubarão, Brazil

Exceeding Expectations

IRON & STEEL >



General view of the blast furnace

At 14:15 on July 21, 2007, a ceremony was held to light the new No. 3 Blast Furnace of Arcelor Mittal Tubarão (formally CST – Companhia Siderúrgica de Tubarão). This event marked the end of the construction and commissioning phases of the project and signaled the start of commercial operations. Siemens VAI was the leader of a consortium of European and Brazilian companies which supplied the complete blast furnace on a turnkey basis. The plant start-up was exemplary. Operational availability was greater than 99 percent in the initial months of operation and the production and quality targets not only met, but exceeded expectations.

Located in Vitória, the capital of Espírito Santos State in eastern Brazil, Arcelor Mittal Tubarão (part of the Arcelor Mittal Group) is a world leader in the semi-finished steel market and is one of the largest companies in Brazil. In order to increase their steel production from five million to 7.5 million tons of steel per year, the company invested in new hot-metal production and steelmaking facilities. Siemens VAI received the order for the design, supply, construction and commissioning of a blast furnace with a rated capacity of 2,800,000 tons of hot metal per year, which

Start-up of the blast furnace

The start-up of the blast furnace was carried out by Arcelor Mittal Tubarão with the support of a multi-discipline team of specialists from Brazil and Europe. The first tapping took place 23 hours after the furnace was lit. Close cooperation amongst all members of the start-up team members ensured that the production targets were quickly and safely met without incident. During the first five days, production was continually increased to heat the furnace refractories and to establish stable conditions inside the furnace. The build-up in production coincided with the hot-commissioning schedule of the new continuous-casting machine.

Key blast furnace start-up figures

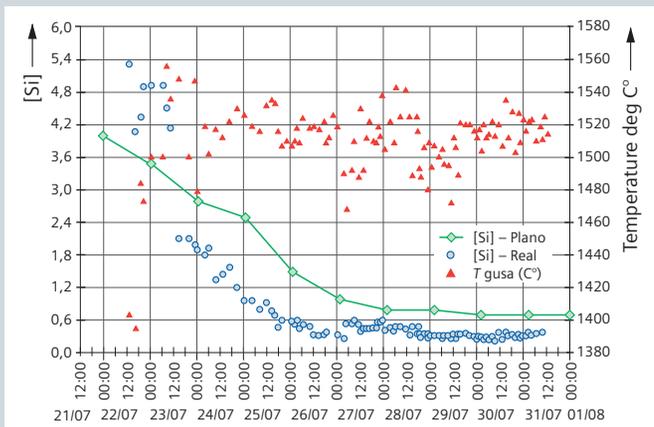
- Blow-in: 14:15/July 21, 2007
- First tapping: 13:00/July 22
- Hot metal to steel plant: 08:00/July 24
- Start of slag granulation: 08:00/July 24
- Accumulated production: 652,500 tons (first three months)

Hot metal quality and output

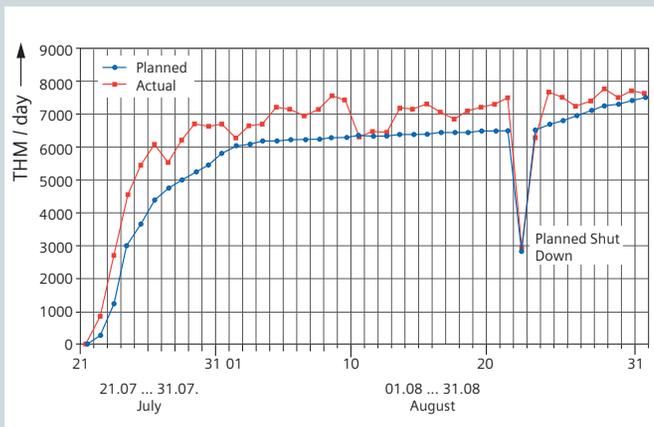
The reliable performance of the equipment allowed an aggressive burdening strategy to be followed so that hot metal of steelmaking quality could be tapped in less than three days. Following the initial furnace heat-up, production was increased smoothly in accordance with the start-up timetable. Furnace availability was 100 percent up until the scheduled plant shutdown one month after blow-in. In the first three months of operation overall furnace availability exceeded 99 percent. Guaranteed production targets were easily met. Following the initial start-up period, production was steadily increased to the design level of 7,840 tons of hot metal per day, which was achieved on September 23 (two months of operation). The furnace output could be maintained at 8,400 tons per day.

Concluding remarks

The successful completion of this project is yet another example which demonstrates the experience and expertise of Siemens VAI in the design and construction of large-scale blast furnaces. The outstanding cooperation between the teams of Arcelor Mittal Tubarão, Siemens VAI and other suppliers and well as the highly professional project execution were decisive factors for the rapid plant start-up and fulfillment of all production and quality targets. ■



Hot-metal quality



Blast furnace production following start-up

was implemented on a turnkey basis in consortium with other companies. The furnace has a hearth diameter of 12.5 meters, an inner volume of over 3,600 m³ and was designed as a free-standing stove-cooled shell inside a splayed leg tower. It is equipped with 34 tuyeres and four tapholes. In addition to the engineering and supply of the primary blast-furnace equipment, the scope of the order included the supply and installation of more than 25,000 tons of refractories for the high-efficiency hot-blast stove plant with a waste-heat-recovery system.

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Start-up of the first Corex plant at Baosteel and receipt of second order

China Goes Corex

Following 30 months of intensive engineering and on-site construction activities, the first Corex Plant C-3000 was tapped at 11:02 on the morning of November 8, 2007. The new plant, capable of producing 1.5 million tons of hot metal per year, was built at the new steel works of Shanghai Baosteel Group Corporation (Baosteel) in Luojing/Shanghai, China. Substituting coke, a wide range of coals can be directly used in the Corex Process for the smelting-reduction operations, considerably reducing raw-material costs and environmental emissions compared with the conventional blast-furnace route.

IRON & STEEL >



Hot-metal tapping on the day of the Corex plant start-up



Baosteel is one of the largest steel producers in China. As part of a steel-plant-relocation project, the former Shanghai No. 3 Steel Works of Baosteel was rebuilt at Luojing in the Baosteel industrial area on the western outskirts of Shanghai. According to Christian Böhm, sales manager for smelting- and direct-reduction technology at Siemens VAI, "A precondition for this steel works project was that extremely strict environmental regulations imposed by the municipal government had to be met. In addition to the cost advantages offered by the Corex process, far lower environmental emissions are achieved because coking plants and sinter plants are not required. These were decisive reasons why Baosteel chose Corex technology."

Project scope and implementation

In June 2005, Siemens VAI received a contract from Baosteel for the supply of the Corex C-3000 plant facility – the largest in the world. The project scope included process engineering, engineering of key plant areas as well as the design and supply of core equipment and components. These included the coal dryers, hot-gas generator, oxygen burners, screw conveyors for the reduced iron and coal, two Gimbal-charging systems (one for the charging of burden into the reduction shaft and one for the charging of coal into the melter gasifier), the gas-cleaning equipment and hot-dust recycling systems, cooling-gas compressors, gas-gate valves, electrical equipment for Level 1 and Level 2 automa-



View of Corex plant, Baosteel/China

tion and also core instrumentation. Advisory services for local manufacturing, engineering erection and plant start-up as well as training were included in the Siemens' scope of supply.

In the course of this project which lasted 30 months from the contract signature to the tapping of hot metal, over 5,000 pilings were installed and 10,200 tons of steel structure were erected – 100 tons more than the weight of the Eifel Tower. The height of the Baosteel Corex tower is 118 meters, which is 15 meters higher than the Statue of Liberty. More than 4,000 on-site working personnel were involved in the construction of the Corex plant. Böhm continued: "That a project of this size and complexity could be completed within

such a short time period is a testimony of the outstanding efforts, coordination and the will to succeed by all parties involved."

Second Corex order from Baosteel

Within only seven weeks following the successful start-up of the first Corex C-3000 plant, Siemens VAI received the order from Baosteel for the supply of the second Corex plant of the same production capacity. With this investment, Baosteel will be able to increase the output of hot metal at the Luojing site to approximately three million tons per year.

The new plant will be built adjacent to the existing Corex facility, allowing for an optimized plant infrastructure and raw material logistics. Böhm further: "A decisive reason for this second Corex order from Baosteel was the excellent results achieved with the recently started up first facility. The full of advantages of the Corex Process could already be demonstrated in a short time."

For this second project Siemens will provide process engineering, engineering of key plant areas, and the design and supply of core equipment and components. These includes oxygen burners, screw conveyors for the coal and reduced iron, two Gimbal-charging systems, the dust-recycling system and various dust- and gas-lock armatures. Electrical equipment for automation systems as well as measurement and control instrumentation will also be supplied. Advisory services for erection and plant start-up will round off the Siemens project scope. The plant start-up is scheduled for mid-2010.

Concluding remarks

Baosteel's decision to implement Corex technology marks the beginning of a new era of ironmaking in China. It reflects the growing national concern and emphasis placed on applying environmentally compatible and economical technologies in connection with industrial growth, development and progress. The successful start-up of the upscaled next-generation Corex plant at Baosteel means that Corex is not only a future-oriented technology for China, but a technology for today for all producers of hot metal worldwide. ■

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More Information

www.siemens-vai.com/corex



Start-up of the Finex plant, Pohang, Korea

Triumph of Innovation

Wednesday morning, April 11, 2007. The sun had just risen over the ocean to the East of the Pohang Steel Works. After an agonizing night of worry and tension, the harsh contours of the Finex steel structure were suddenly bathed in the golden glow of sunlight. This day would mark the dawn of a new era in ironmaking ...

Shortly before 6:40 a.m. the taphole drilling machine was swiveled into position adjacent to the massive wall of the Finex melter gasifier. Around 100 operators, foremen, technologists, metallurgists and management gathered on the casting floor and waited. Many were exhausted and nerves were as taught as piano strings. In the words of Dr. Johannes Schenk of Siemens VAI, one of the pioneers of Finex technology, "We were about to witness the culmination of 15 years of process development to industrial appli-

cation. Although there is always a certain element of uncertainty with every plant start-up, this is especially true when it is a completely new technological process."

The hammering of the drilling machine began. Sirens wailed. A circular hole was drilled through the refractories, and then ... nothing happened! In a split second, operators of the casthouse team grabbed oxygen lances and began with what is known as lancing to clear the tap-hole opening. Suddenly, at exactly 6:55 a.m., a radiant light lit up the casting bay. 175 tons of liquid hot metal gushed forth from the new Finex plant for the first time. A new era in ironmaking had dawned.

Process development and implementation

Since 1992, the Austrian plant builder Siemens VAI (formerly Voest-Alpine Industrieanlagenbau/VAI) and the Korean steel giant Posco have been co-developing the Finex ironmaking process. Following initial laboratory and pilot-plant tests, a Finex demonstration



April 11, 2007 – First tapping of hot metal from the Finex plant

plant with a nominal capacity of 2,000 tons/day was built at Pohang, Korea, and started up in May 2003. On the basis of the successful results and following optimization of equipment and process parameters, Posco signed a contract with Siemens VAI on August 16, 2004 for the engineering of an industrial Finex 1.5M Plant (rated production capacity of 1.5 million tons of hot metal per year). The facility was built within the company's existing steel works

in Pohang and started up on April 11, 2007. Up until December 31, 2007 a total of 957,000 tons of hot metal were tapped from the

plant. According to Schenk, "The nominal melting rate was already achieved within several days following the first tapping. No one had expected that the plant start-up would have proceeded so smoothly and that production could be ramped up so fast. Problems which normally have to be expected during a typical plant start-up just didn't happen." The quality of the hot metal fully satisfies the requirements for subsequent processing in Posco's steel works. Export gas from the Finex plant is used in Posco's own works, primarily for the generation of electricity in a combined-cycle power station.

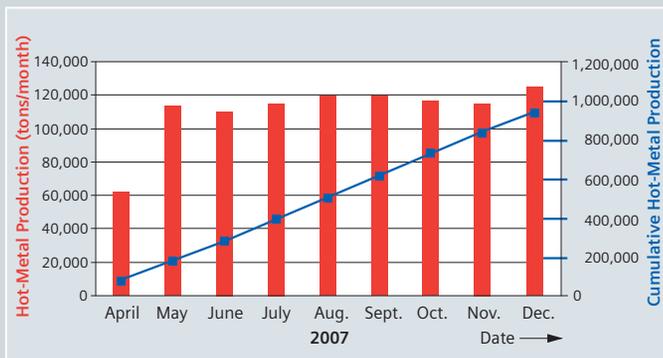
Process benefits

In the Finex process the use of low-cost iron-ore fines and non-coking coals for the production of hot metal drastically reduces raw material costs. Total investment

expenditures and environmental emissions, particularly with respect to SO_x, NO_x and dust emissions, are also far lower than in the blast-furnace route because coking and sintering plants are not required. In the words of Dr. Sanghoon Joo of Posco, also a pioneer of Finex technology, "A 1.5 million t/a Finex plant can produce hot metal more cost effectively than a modern three million t/a blast furnace. When oxygen and power plants are included in the comparison, the capital and operating costs of a Finex plant are roughly 20% and 15% lower, respectively, than the blast furnace route."¹⁾ Finex thus offers producers the potential to slash total costs in ironmaking with the added benefit of environmentally compatible operations.

Concluding remarks

The start-of the Finex plant represents a triumph of joint industrial development and innovation between Posco and Siemens VAI, showing how the combination of engineering, plant-building and operator know-how of two powerful partners can lead to the implementation of a new ironmaking process. Although Finex tech-



Hot-metal production on monthly and cumulative basis

nology is relatively new on the market, it can already compete with the conventional, well established blast furnace route. With consideration to the optimization capability of every new technology, the Finex Process thus has the potential to revolutionize the iron and steel industry, similar to other breakthrough technologies such as the LD (BOF) steelmaking and continuous casting processes.

¹⁾ C.-O. Kang, H.-G. Lee, S. Joo (Posco, Pohang, Korea), J. Schenk, C. Böhm (Siemens VAI Metal Technologies, Linz/Austria); "An Update on FINEX® Technology Development," Lecture presentation held at Metec InSteelCon, June 14, 2007, Duesseldorf/Germany.

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Interview with Dr. Schenk: All about Finex

The Finest Way to Reduce Ore

Dr. Johannes Schenk, process engineer for reduction technology at Siemens VAI, is one of the pioneers of Finex. Since 1992, he has been involved with the process development of this revolutionary technology, necessitating more than seventy trips to Posco's Pohang Works in Korea where Finex was first implemented. Dr. Lawrence Gould, editor for **metals & mining**, interviewed J. Schenk in Linz, Austria on January 11, 2008.

What were the major challenges in the development of the Finex process?

Dr. Schenk: There are both technical and non-technical aspects that have to be dealt with during the development of any process. Technical problems can usually be solved with a strong know-how background and with the right engineering approach in a project team. Non-technical problems, which usually have to do with project financing, strategy, cooperation within the team and with the development partner, require a different solution approach. Often, this takes place on an emotional level. And then, when the outcome of a technological process is uncertain, there are always the pessimists, and one must have the courage to find the right path through a minefield of problems.

What were the key factors for the success of this project?

Dr. Schenk: First and foremost, it was the fact that there were two very strong partners in their respective business fields: Posco, as one of the world's leading steel producers, and Siemens VAI as a leading metallurgical plant-builder. On both sides the project was strongly promoted by managers with a clear vision and a strong commitment. One must remember, however, that "vision is not seeing the ordeal of getting there." The sheer amount of human effort and dedication by both project teams necessary for the project success cannot be overestimated.

How long did it take from the original idea up to the start-up of the Finex commercial plant?

Dr. Schenk: The first ideas for the Finex process go back to around 1990. The subsequent development period and the time required are typical for metallurgical plants of this type. A series of development steps are required, from theoretical calculations, lab and bench-scale tests, pilot-plant investigations, up to an industrial-scale demonstration plant and the commercial facility itself, to ensure that the upscaling of the process is technologically and economically feasible.

In what type of steel works environment would a Finex plant be suitable?

Dr. Schenk: Finex plants can be installed in a green-field location or within an existing integrated steel works where the production capacity is to be increased or where outdated blast furnaces are to be replaced.

How do the investment costs compare for a Finex-based and blast-furnace-based production route?

Dr. Schenk: We believe that with the next generation of Finex plants, which will produce two million tons of hot metal per year, total investment costs will be around 20% lower than the blast-furnace route, and that production costs will be about 10–20% lower, depending on the raw material and energy situation.

Is it true that Finex operation requires coke? If yes, why, and how much?

Dr. Schenk: It is true that Posco currently charges about 30–50 kilograms of coke to the process per ton of hot metal tapped. The reason for this is because Posco is an integrated steel works where excess undersized coke is readily available and can be charged to the process. And it is a fact that with the use of coke the process can be more easily controlled and a higher hot-metal output achieved. The total energy consumption is also reduced so that the overall economics is favorable at Posco. We believe that a completely cokeless operation of the Finex plant is possible, however, this would place increased demands on the coal quality.



Dr. Johannes L. Schenk,
Finex project manager at Siemens VAI

Are the large quantities of excess gas a bane or a boon?

Dr. Schenk: At Posco, the current fuel rates are comparable with the blast furnace on a unit hot-metal basis. Excess blast furnace gas is used for firing the coking plants to produce coke, to heat the hot-blast stoves as well as for other heating purposes. In the Finex process the excess gas energy is used for generating electricity in a combined-cycle power plant, whereby a minor portion of the electrical energy is needed to produce oxygen required by the process itself.

If Finex is working so well, will we still need Corex?

Dr. Schenk: On a worldwide basis, approximately 50% of the mined iron ore is sinter-feed quality, 15% is lump ore and the rest is used for producing pellets. Iron ore in sinter-feed quality is ideal for Finex. In some coun-

tries, for example, the USA or Russia, nearly no sinter-feed iron ore is available, but only concentrated iron ore fines with a grain size too small for sintering. These have to be first processed to pellets. In such countries the Corex process based on pellet and/or lump ore for the production of hot metal would be applied.

I think that it is important to mention at this point that our company is the only company in the world capable of offering the whole range of ironmaking solu-

“Vision is not seeing the ordeal of getting there.”

tions. This includes blast furnaces, direct-reduction plants and smelting-reduction plants such as Corex and Finex. So, we are in the unique position to be able to ideally advise our customers which technological process would best meet the given raw material conditions and production requirements.

What are the estimated capacity limits of Finex?

Dr. Schenk: Present plant capacity is 1.5 million tons per year and the next generation of Finex technology is being developed for two million tons per year. The actual limit is not really known at this time, however, we expect that on the basis of existing fluidized-bed dimensions applied in other processes such as combustion plants and the proven design aspects of large-sized blast-furnace hearths, annual production figures of four million tons should be possible with Finex.

What comes next?

Dr. Schenk: We are currently focusing on the further optimization of the process. This includes reducing investment expenditures, lowering the energy consumption and increasing plant availability. Customized concepts for the integration of the Finex, oxygen and power plants are being developed to further improve the overall energy efficiency, which reduces CO₂ emissions to the environment. The next generation of Finex plants is expected to be ready by mid-2008. Rather than chasing after new visions, it is now time for our customers and company to profit from this revolutionary technology. ■

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Completion of the largest single-line stainless steel works in the world

A Brilliant Outlook

Carinox is the name of the new stainless steelmaking plant of Ugine & ALZ in Charleroi, Belgium. The meltshop is part of the European-based flat-product stainless-steel branch of Arcelor Mittal, the largest steel producer in the world. Following the successful completion of all guarantee tests in March 2007, this project has come to a successful conclusion for Siemens VAI. The Carinox plant is capable of producing approximately one million tons of ferritic, martensitic and austenitic stainless-steel grades per year.

For this milestone project Siemens VAI was responsible for the overall engineering, erection and commissioning of the steel works. This included the turnkey supply of a 160-ton electric arc furnace, a 180-ton AOD converter, a twin-180-ton-stand ladle-treatment station with a common furnace, a single-strand slab caster in addition to auxiliary plants and the dedusting and automation systems. The plant was compactly designed with totally optimized logistics and offers the possibility for future expansion.

Electric arc furnace

Raw materials are transported to the site by either rail or water transport. In the scrap yard different scrap qualities are weighed and loaded in baskets and then

transported to the EAF bay. The EAF itself has an eight-meter diameter, and as such is the largest sized furnace employed in stainless steelmaking. It is complimented by a 160-MVA transformer which is the most powerful in the world used in stainless steel production. A Level 3 planning system provides the setpoints to the automation system. A process model calculates a cost-optimized melting practice for each single scrap blend. The required flux and alloy additions are accurately calculated and automatically charged to the furnace. A dynamic regulation system maximizes the power input and monitors and controls thermal radiation. The economy of operation is further increased through the injection of oxygen and carbon/FeSi through the open slag door by means of a water-cooled lance. This pro-





Carinox stainless steelmaking plant

motes the formation of a foamy slag in the refining phase which considerably improves the furnace melting efficiency through reduced energy losses. During operations, the EAF is completely enclosed within a doghouse to minimize noise and dust emissions.

160 tons of liquid stainless steel are tapped into a transfer ladle every 70 minutes in average. Sampling, temperature measurements and the remaining slag quantity present in the steel is carried out before charging into the AOD.

AOD converter

Decarburization of the heat is carried out in an AOD converter. With a diameter of 5.8 meters and a heat size of 180 tons, this is currently the largest converter in

the world used in the production of stainless steel. Oxygen and nitrogen or argon are blown into the heat by means of nine under-bath tuyeres installed in the side walls. Outer annular shroud tuyeres and the application of an intelligent wear-monitoring system protect the inner pipes and maximize their lifetime. The use of a top lance accelerates initial decarburization. The Ugine & ALZ-developed TOP AOD process model allows the exact process targets to be met on the basis of input data from the EAF, raw materials and additives. The average AOD tap-to-tap time is 70 minutes. During longer waiting times, the temperature of the converter can be maintained using a burner and heat-insulation hood which covers the converter opening when the converter is tilted into the horizontal position. >>

160-Ton electric arc furnace



Ferro-alloy/additive-handling system



180-Ton AOD converter



Twin-station ladle furnace

>> The ferro-alloy additive-handling and -charging system is comprised of 28 bins and operates fully automatically. It supplies both the EAF and AOD plants.

Twin-stand ladle furnace

The heat is transported by crane from the AOD to one of the twin-ladle furnace stands where stirring, compositional and temperature adjustments of the heat can be carried out. The stands also serve as efficient steel buffers in the case of an unexpected production delay. Alloying materials are charged to the ladle furnace from a high-level alloy-bin system and each stand is equipped with a multi-line wire-injection facility.

Dedusting system

Primary emissions from the EAF (1.3 million m³/h) and AOD (1.1 million m³/h) plants are cleaned in a bag-fil-

ter station equipped with pulse-jet cleaning. All other plant emissions are filtered in secondary dedusting systems. A clean-gas dust content of less than 5 mg/Nm³ conforms to the latest European regulations. Valuable solid residues can be recycled to the steelmaking process.

Continuous slab-casting machine

The continuous slab-casting machine is designed to cast more than one million tons of slabs per year at thicknesses from 150 to 250 mm and in widths ranging from 1,000 to 1,650 mm. Two tundish cars, each equipped with a submerged entry-nozzle-changing device, preheating hoods and a nozzle preheater, support long casting sequences. A top-feeding dummy-bar system considerably shortens downtime between two sequences. Featuring the latest mold technology, hydraulic oscillators, electromagnetic strand stirring and



Slab
caster

SmartSegments, the caster is ideally suited to meet all production and quality requirements. Casting speeds of up to 1.4 meters per minute are possible for ferritic steel grades. The automation system includes automatic mold-level control, breakout prediction and dynamic cooling models for improved operational safety.

A torch-cutting machine cuts the slab to lengths from 5–12 meters. Slab surfaces are ground by one of the four grinding machines. The close proximity of the Carinox plant to the Carlam hot-strip mill and the use of insulation hoods allow the slabs to be hot-charged to the rolling mill.

Leading supplier

With the completion of this project, the Arcelor Mittal group, the largest steel producer in the world today, has acquired a leading position in the stainless steel market. The Ugine & ALZ division in Charleroi, Belgium

now supplies approximately 25% of the European market with high-quality stainless steel hot- and cold-rolled products.

Concluding remarks

The large production capacity of the stainless steel works, coupled with efficient and flexible production scheduling, are key reasons for the economic feasibility of this plant. Advanced process technology, robust and reliable plant equipment, well trained operational personnel and the excellent cooperation between the Ugine & ALZ and Siemens VAI project teams were decisive for the overall success of this project. ■

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LiquiRob – A new dimension of safety in continuous casting

Caster Robot

In a steel works environment, particularly where liquid hot metal is produced, operators are continually exposed to dangerous working conditions. This is particularly true on the caster platform because of the large number of accidents that can occur. Because operator safety must always be accorded the highest priority, Siemens VAI has therefore developed a robot system named LiquiRob.

With this solution, all manual tasks normally performed by operators on the caster platform can be carried out automatically, allowing surveillance and control of continuous casting operations from the safety of the control room. By removing caster operators from hazardous working areas, human injury can be avoided. Following intensive

development work and exhaustive testing in the workshop, Siemens VAI developed the LiquiRob robot system capable of performing a multitude of tasks. Due to the flexibility of the system, it is suitable for application in all critical areas along the entire iron and steel production route, both in EAF and BOF steel mills.

In the continuous casting process LiquiRob can be ideally applied. Individual units are employed to carry out specific duties in the following caster areas:

- Ladle-loading position: handling of ladle slide-gate cylinders and media couplings, etc.
- Tundish area: temperature measurements and sampling, tundish-powder dosing, ladle-shroud handling and oxygen lancing of ladles, etc.
- Mold area: sampling, powder dosing, slag removal and insertion of steel-quality-separation plates

The action radius of LiquiRob can be maximized through the mounting of the robot on a moving platform, which can either be rotated or shifted linearly. A special feature of LiquiRob is that with the use of a specially developed 3D position-detection system, equipment such as ladle slide-gate cylinders, media couplings and submerged entry nozzles, etc., which does not have a fixed position, can be quickly located and accurately manipulated by the robot. The robot unit is well protected and designed for operation in the harsh environment of a steel mill (foundry-type classification), minimizing maintenance requirements.

Industrial application

In June, 2006, Siemens VAI received a contract from the Korean steel producer Posco for the installation of a new 2-strand slab caster at the Gwangyang Steel Works. With the goal of increasing operator safety, this project also included the installation of a LiquiRob system. The robot was designed to automatically carry out sampling and temperature measurements of the steel in the tundish, in addition to powder dosing. The caster was successfully started up in November 2007. Thanks to the systematic operating procedures of LiquiRob, a high level of personnel safety and process reliability could be attained. The system can be upgraded to perform additional functions, such as ladle-shroud handling and oxygen lancing of the ladle.

The next LiquiRob installation will be implemented in a slab caster of a South American steel producer in the Spring of 2008. At a different steel works, a modified version of LiquiRob will be employed for sublance-probe handling of the steelmaking converters. ■



LiquiRob in operation

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Start-up of first of four replacement converters at NTMK (New converter to the left, next converter to be replaced to the right)

Successful start-up of 1st BOF converter at Nizhny Tagil, Russia

Progress Report

As part of a major modernization program underway at the Russian steel producer Nizhny Tagil Iron & Steel Works (NTMK), the existing BOF converters and environmental facilities are currently being replaced by Siemens VAI. The first of four converters has since been exchanged and was started up in November 2007. Only 75 days were required for on-site work up to the converter start-up.

As already outlined in the No. 2/2007 issue of metals & mining, a monumental project is currently being implemented at NTMK to increase steel output and to modernize production facilities. The project scope for Siemens VAI includes the replacement of the existing four converters with new 160-ton-capacity converters, including the supply of electrical equipment, automation, upgrading of the outdated off-gas-treatment system and modifications to the storage

bunker and charging system. The major challenge of this project is that all onsite installation work is to be performed during full steel-production operations and within a very tight time frame of less than three months for each converter replacement.

Within only 75 days – 15 days less than stipulated by the contract – Siemens VAI replaced the first converter which was started up on November 5, 2007. The extremely short time for this replacement was achieved through meticulous engineering planning and intensive on-site activities carried out seven days per week. From the converter start-up until December 31, 2007, altogether 1,310 heats were tapped with an average tapping weight of 153.38 tons and a total of 200,928 tons of steel were tapped. The prescribed dust-emission values were fully met. The second converter will be replaced in March/June 2008, the third in the fourth quarter of 2008 and the remaining No. 4 Converter in 2009. With a larger converter size and shorter tap-to-tap times, the annual steel output of each converter will be increased from approximately 900,000 tons to 1.1 million tons. At the same time, the cost-effectiveness, environmental emissions, onsite working conditions and steel quality will be dramatically improved. ■

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Advanced strip temperature controller for hot rolling mills

Temperature under Control



To achieve well-defined material properties, it is desirable not only to control the finishing temperature but to achieve a certain temperature course of the material in the finishing train. Siemens has developed a Model Predictive Control (MPC) to realize required temperatures at certain positions inside the mill. Besides the strip speed itself, the water flow through continuous variable inter-stand cooling devices can be used as actuators.

Classical temperature control in a finishing mill uses strip speed as only (and slow) actuator. Precision is limited because of dead times. Typically only application of fuzzy rules can stabilize the control when skid marks come into play. To overcome these shortcomings, an MPC has been developed and successfully tested on several hot strip mills. Technically, the MPC employs a strip temperature monitor, which itself is based on a physical temperature model.

Strip temperature model

Any model for the calculation of the strip temperature in a hot strip mill must be able to describe certain physical effects. These include:

- Heat loss by radiation
- Reflected radiation from the roller table bottom side and from heat insulator panels
- Heat transfer to roller table and work rolls
- Temperature increase due to deformation and friction work in the roll gap
- Heat loss due to impinging water jets
- Influence of phase transformation.

High precision is realized through computation of the temperature for several layers over thickness. Through adaptation of the heat transfer coefficients (rather than only using meaningless correction factors) we make sure that basically the complete temperature course is adapted.

Fig. 1. The set of all strip points (SP) represents the state of the strip, i.e. the enthalpy $h(t,x)$ and the volume fraction of ferrite $p(t,x)$

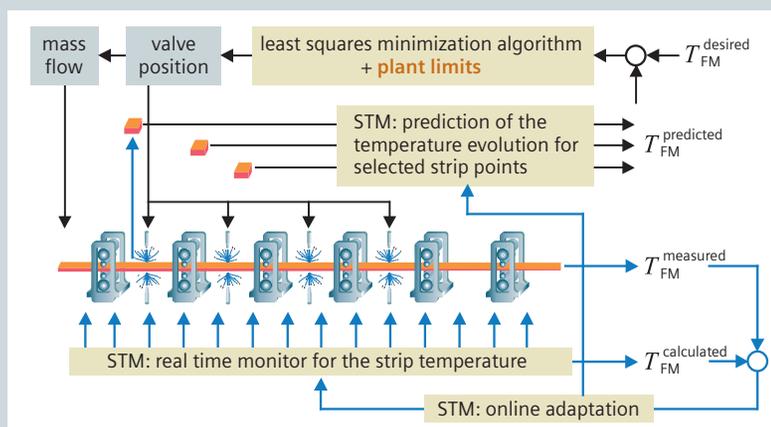
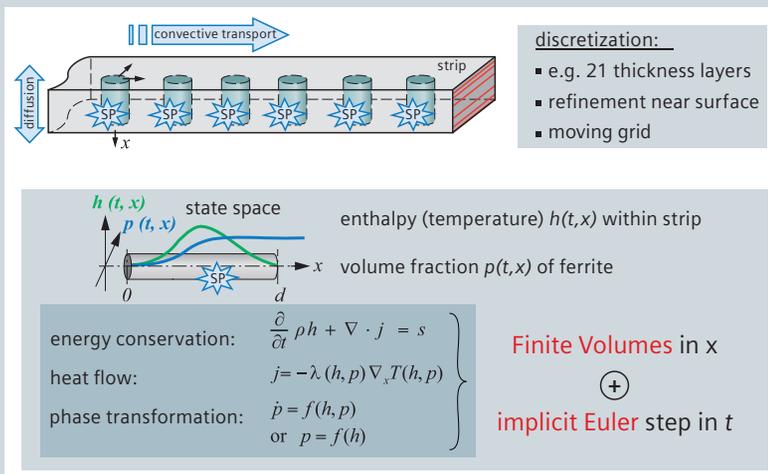


Fig. 2. MPC flow chart

Main Benefits

- Monitors strip temperature in real time
- Uses strip speed and/or water cooling for temperature control
- Allows for temperature setpoints inside the finishing mill
- Renders dead times and constraints uncritical

Strip temperature monitor

Since no temperature measurement is available within the inter-stand region, a Strip Temperature Monitor (STM) provides the temperature distribution in both thickness direction and length of the whole strip. Based on a certain sampling rate, the monitor generates a 'strip point' (SP) at the position of the first relevant temperature measurement, which is usually the roughing temperature. A strip point represents the temperature (or enthalpy) profile across the thickness as well as the mass fraction of the remaining austenite at a certain location in the strip (Fig. 1).

It is initialized with data from the measuring device and/or data provided by the automation system that processed the strip upstream. After initialization, the STM tracks the position and the state evolution of each individual strip point as it moves through the mill. As a consequence, the STM provides an image of the

current temperature field at each sampling time (see lower half of Fig. 2).

Model Predictive Control

The Model Predictive Control (MPC) algorithm uses the mill state known from the STM in conjunction with the strip temperature model to predict the temperature course into the future. Then, deviations between target temperature values and predicted ones are minimized using an optimization algorithm for identification of the future actuator values. Figure 2 shows the main components of the MPC for strip temperature. This figure illustrates the most general case of controlling the strip temperature by mass flow and by four interstand cooling devices. Strip points taken from the STM are predicted up to the time they will reach the temperature gauge behind the finishing mill. Direct benefits of this approach include elimination of the problems associated with handling dead times.

Based on the difference between the calculated and desired temperature values, the MPC algorithm calculates the new control signals, such as the mass flow of the strip and the cooling flows, by minimizing the control objective. This procedure simplifies implementation of constraints for control or state variables.

Reaping the benefits

MPC is able to treat the extended delays that are relevant for controlling the temperature in hot strip mills. Compared to existing controllers, Siemens' new MPC is able to use inter-stand cooling devices and the mass flow simultaneously for controlling the strip temperature.

Technical constraints on the control variables such as maximum water flow or maximum strip speed can also be included easily. Since the MPC is based on a precise strip temperature model, it is even possible to control temperatures that are not directly measured, such as the temperature average over the strip thickness behind the second stand inside the finishing mill. The first model predictive controller was commissioned at the finishing train of the casting-rolling plant of MaSteel in China in 2003. It has entered the Siroll^{CIS} HM standard. Meanwhile, plants worldwide benefit from this solution, incl. hot strip mills of Severstal in Russia, Tangshan Guofeng Iron and Steel Ltd. and Tangshan Iron & Steel in China. The latest application has been realized in the conventional Shougang Iron & Steel Co., Ltd. hot strip mill in China. Further applications are in engineering or commissioning phase. ■

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Commissioning a unique new heavy gauge downcoiler at Fos/Mer

On A Roll

A new heavy gauge downcoiler B4 was successfully installed and commissioned at ArcelorMittal's Fos/Mer hot strip mill in France, during the 12-day annual stoppage. Engineered in collaboration with Siemens VAI France and manufactured at the Siemens VAI Montbrison workshop, this 4-wrapper hydraulic downcoiler, note the authors, is specifically dedicated to the heavy gauge pipe market for oil/water transport application and is designed for processing coils up to 1850 x 25. 4 mm² in X70 grade, making it the world's most powerful coiler to date.

The experience of ArcelorMittal Fos-sur-Mer with the B5 hydraulic coiler has shown that, to reach the target, the principal difficulty lies in the first wrap. With this in mind, preliminary investigation was conducted, including the thorough analysis of the coiling process based on extensive Finite Element Modeling.

This study led to the definition of coiler features: 4 wrappers, specific first wrapper design and control, and heavy duty pinch roll with pre-bending capabilities. Two operating modes have been developed for this coiler: classic mode with AJC and a heavy gauge mode, both at the pinch roll (press roll used as a pre-bending roll) and at wrapping roll level. The heavy gauge mode is an important innovation of Siemens VAI, designed and dimensioned with finite element simulation.

Finite element simulation yielded a first set of data (pinch roll gap, wrapper force, etc) used for designing. These calculations have also been used for commissioning and primary trials. The design of the first wrapper and its force control is a critical point, ensuring the capacity for the machine to coil the targeted product.

Further studies also enabled, by a specific coiling process, to use the existing mandrel, wrappers, and pinch roll motors. It was decided that the switchover between the two modes should be based on coilability index (equal to strip width x thickness² x hardness at coiling temperature), which is representative of the energy to be applied to the strip. The new coiler can reach and index of 81 (compared to a world maximum of 60 to date).

Installation and start-up of the new coiler

The coiler and pinch roll were completely pre-assembled and partially tested at the Siemens VAI workshop. Comprehensive onsite integrated tests of the downcoil-

er assembled offline were carried out with hydraulic fluid and automatic systems functioning to ensure a smooth start-up.

In order to keep mill stoppage to a minimum, the new coiler was assembled offline on an extension of the stripping rails of the existing coiler. During the stoppage, the existing coiler was partially dismantled before being removed and being replaced by the new machine laterally shifted from its assembly position outside the building. The pinch/presser unit as well as the guides were also assembled offline. Start-up took place on schedule.

Unique new strip side guides

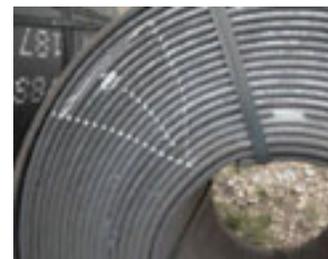
The old electromechanical guides with pneumatic short-stroke were replaced in their

entirety by a hydraulic system. The choice of position control with force limiting control was preferred to that of effort control, which is considered less stable. Force limiting depends on the size and coilability of the strip. As expected, the influence of the new side guides on telescopicity has been very positive.

Run-up to optimum production conditions

Capabilities of the original coiler were reached in 2 weeks (coilability index: 22), and that of B5 (coilability index: 34) in 30 days, in line expectations. Testing and adjustment of parameters of the heavy gauge mode were begun in November 2006, and target product capabilities were reached in February 2007 (coilability index: 81).

The new coiler features a number of innovative capabilities. These include:



Possibility to recoil cobbles without damaging the pinch roll.

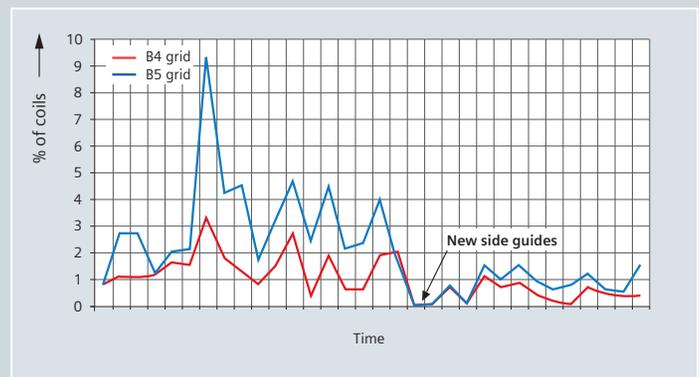
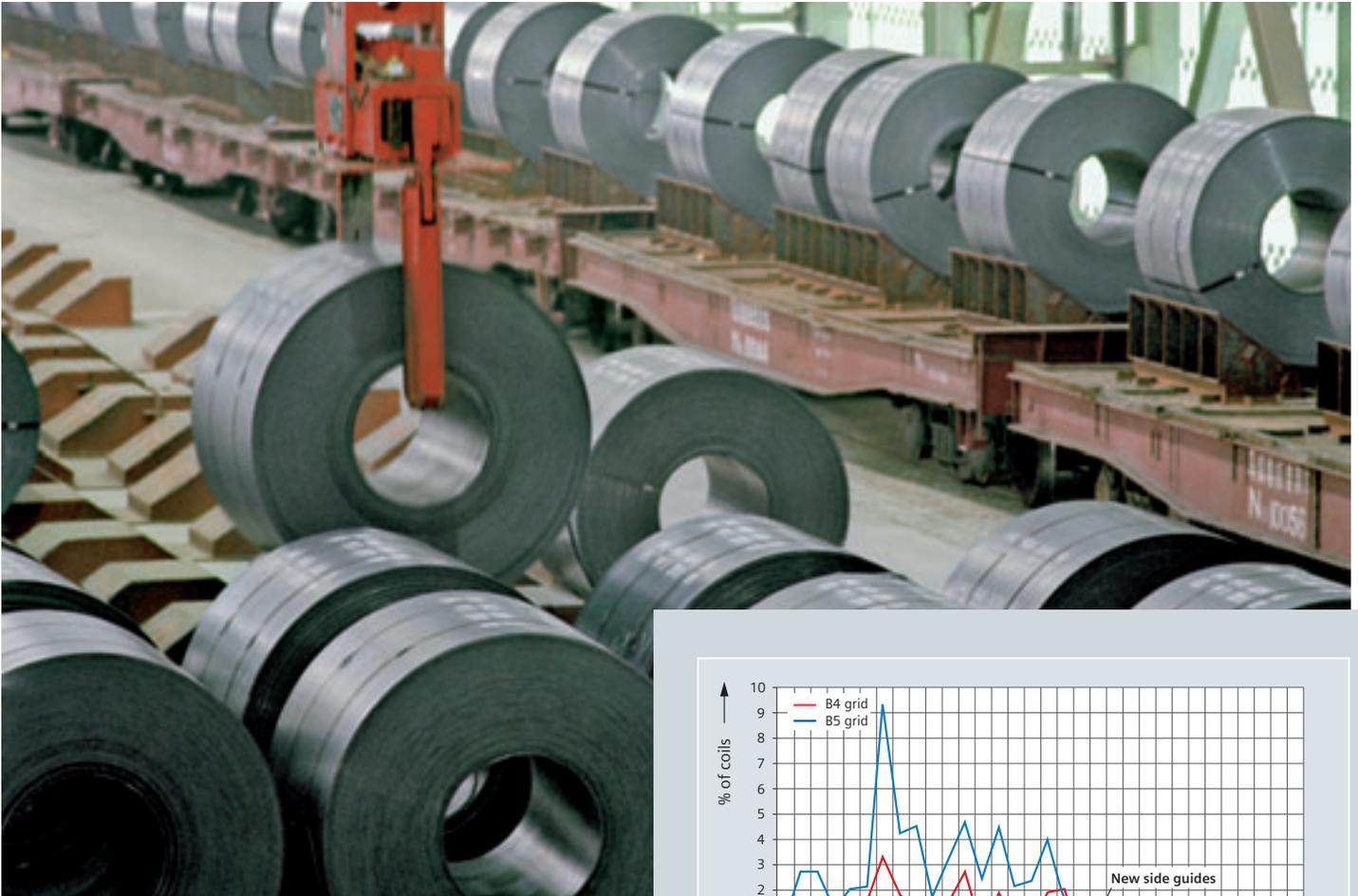


Figure 1: Reworked coild due to coiling quality

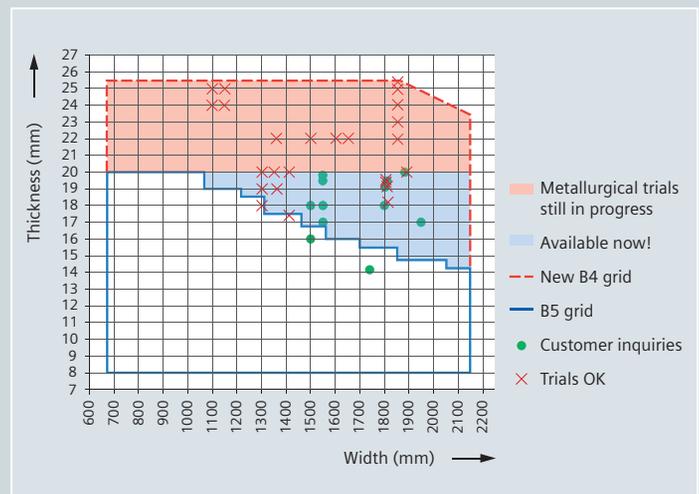


Figure 2: Target parameters for the new coiler

- Modification of roll gap at strip head entry to balance and stabilize pinch roll force. Effectively, after the engagement of the first lap there is an adjustment of the two roll gap (presser and pinch) to accompany coiling and not to increase significantly pinch roll forces.
- Control of force deployment via the n°1 wrapper, with double motorized rolls, in order to ensure the optimum transfer of energy to the strip (Siemens VAI patent).
- Creation of a “mini AJC” at the end of coiling: on heavy gauges, the step effect created by the first lap is still present at the strip tail.
- Creation of a mandrel speed switchover system based on the coilability index in order to ensure the best speed/torque ratio for optimal coiling.
- Possibility to recoil cobbles without damaging the pinch roll, through the use of a “soft” hydraulic model.

Following trials, the target parameters for the new coiler were reached, enabling extension of feasibility grid B4 in the figure 2.

Successful launch into a very promising commercial market

As a result of close cooperation between Siemens VAI and ArcelorMittal, a new generation of downcoiler has been installed and commissioned at Fos/Mer. This project has confirmed the importance of numerical simulation (ABAQUS) for design and process determination, contributing in large part to the on-time restarting of the production process.

This new equipment, combined with the metallurgical expertise in pipe grades, has put ArcelorMittal Fos at the very forefront of a very promising commercial market.

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Record-breaking commissioning and acceptance effort using Siroll^{CIS} PM

Shougang Showcase

Siemens VAI recently provided key electrical and automation equipment and finished commissioning of the new 4300 mm plate rolling mill for Shouqin Metal Materials & Co., Ltd. (Shougang Iron and Steel Group) in China in just 4 weeks and, ultimately, received customer acceptance just 5 months after rolling the first plate. Shouqin is now able to meet current and future market demands for high-quality specialty steel products.

Shougang – formerly known as Capital Steel – is one of the largest producers of iron and steel in China. The company operates a production complex near Beijing with an annual capacity of around 8 million tons of crude steel.

In the course of a comprehensive modernization program and in support of a municipal drive to improve air quality in Beijing, Shougang is currently relocating its production plants to the Hubei Province.

Market-making technology

Advanced systems and equipment from sensors to production control from Siemens VAI ensure flexible and reliable production. For the Shougang project, Siemens VAI supplied a wide range of systems and equipment. The main and auxiliary drive package at Shougang comprises synchronous and asynchronous motors powered by the Simovert D cycloconverter and Simovert Masterdrive systems. The cylindrical-rotor synchronous motors have been especially designed for



All the components and systems used at Shougang are part of the integrated Siroll^{CS} PM solution

robust operating conditions, such as the heavy thermo-mechanical reduction passes in the plate rolling mill.

On a higher level, the Siroll^{CS} PM automation system keeps process parameters within close tolerance limits. By combining advanced analytical process models and sophisticated technological controls, Siroll^{CS} PM can be easily adapted to changes in product range or in quality requirements. A material tracking feature ensures that the operator always has a clear overview of all material flows throughout the plant and can correctly assign measured values, production, and quality. A production control (Level 3) system for Shougang plate mill and as well for the Shougang 2160 mm Hot Strip Mill ensures a seamless link between the Shougang ERP (SAP) system and the process automation systems in various parts of the plant.

In terms of basic automation, Simatic PCS7 / TDC and Simatic ET200 provide sequence control, material tracking, and technological process controls of the reheat furnace and mill main and auxiliary equipment. A common HMI for both process and basic automation, designed around Simatic WinCC, supports the operation, diagnostics, and maintenance of the rolling mill and plate finishing line.

All the components and systems used at Shougang are part of the integrated Siroll^{CS} PM solution for plate rolling mills, which lowers operating and maintenance

expenses, thanks to a consistent and easy-to-understand operating system. From a technical standpoint, Siroll^{CS} PM enables exact tolerances for temperature and geometry for the entire plate length using online process models and neural networks, fast processing of widely differing consecutive plates via multiple set-points, and automatic mill pacing for smooth multi-plate rolling.

These and other benefits have made Siroll^{CS} PM the automaton system of choice at Shougang.

Multi-national system integration testing and release

Just four months into the contract, the customer arrived in Erlangen for execution of basic design followed by a basic design review, detail design, and customer personnel training. After the detailed design work, a combined system integration test was conducted by an international team of software engineers and commissioning specialists of Siemens, Siemens Ltd. China, Shougang High Tech Co., and several other suppliers to ensure a smooth start up to produce the first plate as early as possible. After a remarkably short 3 weeks of testing, the system was released for shipment to China, an achievement made possible only by using innovative Siroll^{CS} PM core software.

Up and running in record time

Close coordination during the design phase, clear definition of interfaces, a thorough system integration test, and use of proven core software solutions from the Siroll product family all contributed to this multi-national effort. But, the scalable and reliable Siroll^{CS} PM drive and automation system, based on Siemens decades of project management experience and cutting edge engineering capability, proved to be the key to getting the Shougang plate mill up and running in record time.

Among the recently built plate mills in China, Siroll technology for electric and automation is included in the plate mills of Baosteel, Baoshan Pudong, Baotou, Angang, Jinan, Xiangtan. In addition, Siemens VAI supplied the complete equipment for the following customers: Plate mills for Shagang, Wuyang, Laiwu, Plate/Steckel mill for Nisco, Steckel mill for Jiuquan (Jisco). Newly received orders for Shagang, Wuhan and Jinan complete the success story. ■

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Completely Integrated solutions for cold rolling mills

Significant Market Success

The demand for cold-rolled steel continues to grow, as time requirements for product quality, mill productivity, availability and reliability are increasing. Continuous Tandem Cold Mills (CTCM) and Coupled Pickling and Tandem Cold Mills (PLTCM) are the answer to these requirements. Since the introduction of CTCMs and PLTCMs in the late 1970s, the concept has migrated to advanced applications, particularly in the automotive branch, while gaining market share of more than 40% among all multistand mills build. The author examines how this worldwide expansion of CTCMs and PLTCM applications is being driven by innovative Siroll^{CIS} CM technology from Siemens VAI.

Continuous Tandem Cold Mills and Coupled Pickling and Tandem Cold Mills not only produce thin strip of standard alloys, but also steel types like Advanced High-Strength Steels (AHSS). voestalpine Stahl and Corus Staal are two of the latest producers of AHSS to have selected Siemens VAI to supply their latest tandem mills in Europe.

In Europe and elsewhere, Siemens VAI has taken a leading roll in developing the mechanics and automation solutions for CTCMs and PLTCMs in more than 42 installations. The sophisticated Siroll^{CIS} CM solution supports the continuous production process while providing key advantages that address the complex technological interaction inside the cold rolling mill.

Siroll^{CIS} CM is part of the Siemens VAI Siroll^{CIS} solution portfolio. It incorporates and implements mechanical, technological and process expertise acquired through the realization of some 500 plants and ranging from continuous casting to the finished coil.

Strip feeding and welding

The strip feeding and welding section has a major impact on the line performance and must be designed to ensure fast pacing and rollable welds, whatever the product grade and size. To achieve these ends, the feeding section must be fully automatic with the shortest downtime possible from the time the tail leaves the pay-off reel to the restart after notching.

In addition to its family of proven flash butt welders Siemens VAI has developed a new heavy gauge welder the LW21H. The welding operation uses a CO₂ Laser source with a fixed resonator. The welder's superb efficiency gives it a high volume capacity for large material mixes including DP, TRIP and manganese steels.

Pickling and trimming

The pickling and trimming section typically comprising FAPLAC (fully automatic pickling liquor analysis and control), side trimmer; inline surface inspection with optional SIAS system; loopers; and bridles for decoupling tension of different line sections, pickling lines and trimming sections supplied by Siemens VAI are characterized by high-output, low-cost operation. Additional features include flexible production, a wide range of product sizes, reliable plant operation, low maintenance requirements, and compliance with the highest standards for environmental safety.



Siroll^{CIS} CM automation concept enables single operator control of complex processes

Mill stand design

Successful strip production of AHSS, in particular, depends on the mill stand. Proven experience in 6-high and 4-high technology makes Siemens VAI a unique partner for cold mill technology.

Drives, drive controls, and power supply

The main and auxiliary drives, in combination with the mill stands, play a key role in the success of CTCMs and PLTCMs.

When it comes to final strip quality, the performance of a multistand mill depends largely on the main drives. As a market leader with numerous reference installations and many years of experience, Siemens has accumulated extensive expertise in providing the right drive concept. Rather than concentrating solely on the converter and motor design Siemens VAI strives to adapt key drive properties, such as inertia, weight and spring constant of the entire drive train, to individual customer needs and to integrate the drive control in the overall automation system.

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COLD ROLLING

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The motor itself and the corresponding converter are selected with the aim of optimizing line reaction, losses and dynamic performance. Siemens drives for this application are reliable, easy-to-operate, require little time and effort to maintain, and exhibit very low power loss.

The requirements for drive systems in rolling mills include adequate power, speed and torque performance to ensure strip quality, high equipment availability to ensure production quantity, low maintenance and energy consumption to ensure low production costs, and competitive pricing. Because all of these requirements cannot be met with just one system, Siemens VAI offers an optimized product portfolio that covers a wide variety of applications with a small number of standard products, ranging from the motor itself to component parts for the roll stack and the feeding line.

Sophisticated automation concept

Technological controls and process models are the core of any sophisticated automation concept with the goal of maximizing utilization of the mechanical, hydraulic, and other positioning elements. The control concepts have evolved with the increasing performance of the equipment – from simple analog PI controllers to highly complex and interlinked control systems. These controls and process models are an integral part of Siroll^{CIS} CM.

The value of the Siroll^{CIS} CM concept is visible in the rolled strip: improved gauge tolerances, less off-gauge material, perfect flatness to meet growing demands worldwide.

Setup and rolling directives

The core of the automation system is the setpoint calculation with the aid of the process models and the rolling directives. An ideal combination of physical models and auto-adaptive algorithms promotes success in process modeling. It is a must for the flexible operation of high-performance CTCMs and PLTCMs.

The advantages of online process models in combination with neural networks for adaptation in the process automation system include the more accurate setpoints for adaptation by neural networks to the actual mill conditions and easy matching of new materials, which enables the rolling of new steel grades.

Siemens VAI process automation also optimizes product quality by permitting a very high degree of flexibility in the parameterization of rolling directives. Rolling directives are derived automatically from specific material characteristics.

Speed optimization

Flexible production planning can result in the ability to run different process speeds in the pickling plant

and tandem mill. Speed optimization aims to maximize the production rate while maintaining the high quality of the finished strip. This function covers planned stops of mill sections, e.g. due to trimming knife changes or roll changes; measured values and signals from the line; technological prescriptions; individual strategies; and reaction to detected strip defects.

Coil building

Siroll^{CIS} CM enables data management and provides setpoint for “m to n coil handling”. An incoming coil consisting of m welded sections can be rolled and divided to n outgoing coils. At the end, Siroll^{CIS} CM incorporates advanced cut control for building coils. The

**Mill exit section**

options include manual cutting, inspection cutting, and jumbo-coil rolling by cut criteria such as coil weight or coil diameter.

The ability to change target gauges on the fly is essential for cost-effective continuous cold rolling. Flying gauge change is a higher-order sequencing and control function that coordinates various system functions in basic automation and the process automation system.

Technological thickness control

Developed by Siemens, the advanced mass flow control concept for tandem mills controls reduction at the individual stands, decouples the stands by means of strip-tension controllers, and achieves very close strip gauge tolerances. A highlight of the Siemens concept is the structured, robust multivariable coupling of gauge and strip-tension control. Intelligent control replaces expensive instrumentation. Roll eccentricity and coil eccentricity compensation systems counteract

the roll-stack and coil eccentricities within the tandem mill itself.

Automatic gauge control and roll eccentricity compensation

Automatic gauge control implements software functions for each mill stand feed-forward control, feedback control, mass-flow control by strip speed metering, roll efficiency compensation, additional acceleration correction for the entry bridle, additional acceleration correction for the tension reel, corrective values for stand modulus (CG) and material stiffness (CM).

Roll eccentricity compensation reduces periodic deviations in strip thickness caused by roll eccentricities.

the control system monitors positioning element priorities as well as speeds. The strip coiling section employs a two-reel arrangement or a more compact carousel reel. For both configurations, an automatic sleeve feeding system can be implemented for thin gauges below 0.3 mm, with one-side, two-side, on the fly, or separate inspection, depending on the application.

Tailormade solutions

Since the introduction of Siroll^{CIS} CM in 1998 it has been continuously developed and optimized. It performs short commissioning times, fast production ramp-up with high strip quality from the first strip on at the the same time. In operation the Siroll^{CIS} CM concept is characterized by operator friendliness, quick re-



Coil handling section

When eccentricity compensation is active, adjustments to the roll gap compensate for these eccentricities.

Special control in the mill exit section

Different gauge control modes can be selected in the last stands of the mill exit section as Tension Optimum Mode A for soft/thick strips, Tension Limited Mode B for hard/thin strips, and Surface Optimum Mode C with the next-to-last stand achieving the specified exit gauge and the last stand acting as the smoothing or skin pass stand.

Flatness control and coiling

Contactles Siflat or a roll based Planicim shapemeter provides measurement. Both measurement systems feature modular design, highly sensitive measurement accuracy and reliable and consistent data acquisition.

Siroll^{CIS} flatness control ensures the best possible roll gap at all times. To achieve best dynamic behavior,

action to changing production conditions and a high maintenance friendliness.

Even for revamping or modernization of existing mills, Siemens VAI again offers tailormade concepts based on the Siroll^{CIS} CM solution, which lead to short downtimes and a quick return to full production. Whether for projects involving the revamping of existing mill facilities or the building of entirely new ones, CTCM and PLTCM technologies from Siemens VAI deliver better product quality at higher production output to meet changing market needs in the most cost effective manner available. ■

Main Benefits

Supports the continuous production process while addressing complex technological interactions

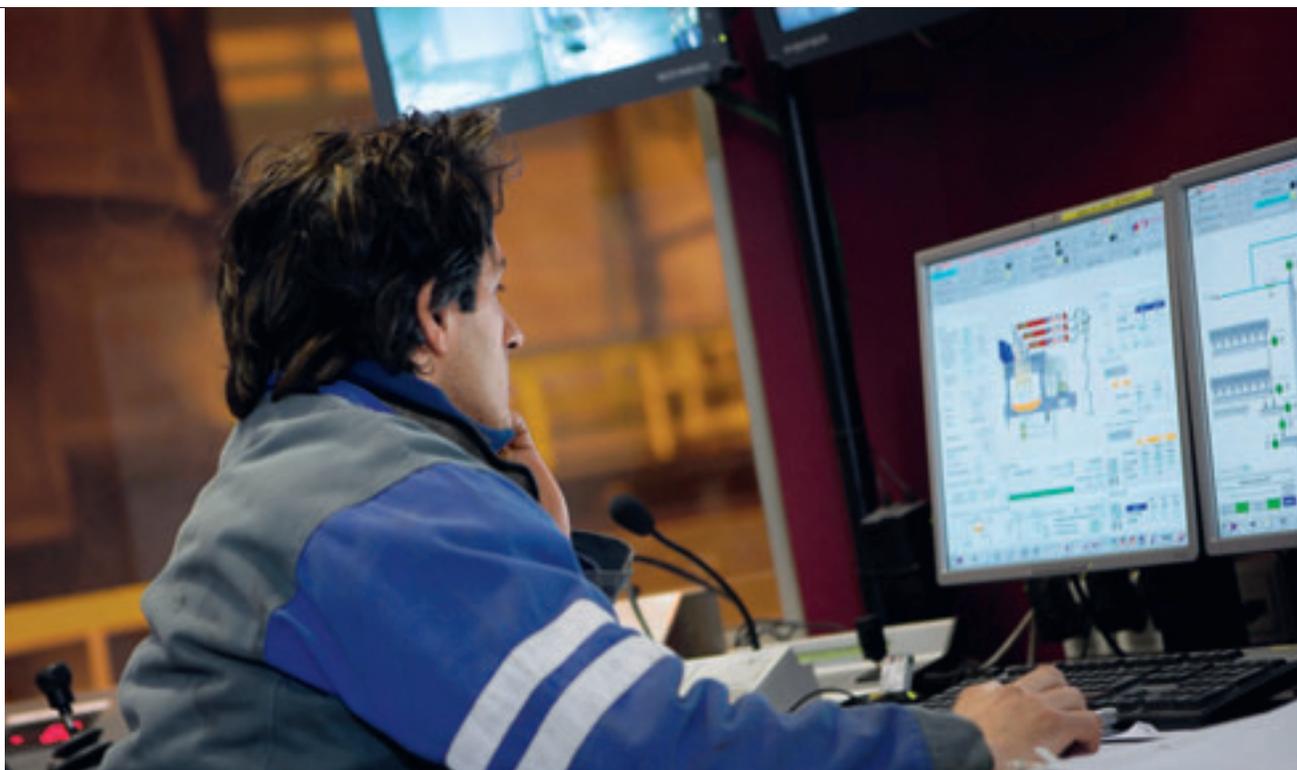
Improves strip gauge tolerances, reduces off-gauge material, and enables perfect surface flatness

Employs neural networks for real-time setpoint adaptation to actual mill conditions

Ensures best possible roll gap and superior dynamic behavior in the production process

Provides an ideal basis for tailor-made solution for greenfield and revamp mill projects.

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Innovative surface inspection system for steel processing

Powered by SIAS



A challenging task: Inspection of surface steel strip

Online surface control is an ongoing field of development for steelmakers. If the value of a steel piece is to be broken down, the three major components are metallurgical properties, geometry, and surface quality. Whereas the two first areas are well-known and gauges or systems to measure and control them in a repeatable manner have been available for decades, surface quality was, until recently, an area requiring expert knowledge from trained inspectors with years of hands-on experience. The SIAS automatic surface inspection system is changing all this.

Inspection of steel strip surface is a challenging task from an image processing point of view. Steel texture typically provides a noisy image where it is not easy to look for information. Some defects are very subtle and would be difficult to pick-up even by a trained inspector. What is more, defect diversity makes it challenging to automate their identification.

Siemens VAI expertise in the field of image processing has enabled the company to develop the SIAS system based on highly elaborate techniques and algorithms, which is truly accessible and configurable by the end-user alone, without having to rely on expert knowledge. Aids include a state-of-the-art image-based classification builder, follow-up indicators, and image archiving capability that supports maximum efficiency at commissioning stage. The four main reasons for introducing SIAS automatic surface inspection technology are:

Prevent defect crisis. The role of SIAS, in this case, is to alert the line/mill operator on the presence of certain defects (e.g. roll marks) as early as possible, facilitating immediate corrective action. The system is used as a production watchdog.

Protect the production tool. Some defects may cause major problems in the downstream production processes if they are not detected early enough. An example is the presence of edge cracks on pickled product. If the strip is cold rolled, these defects may lead to the strip breaking while under tension in the rolling mill, leading to mill downtime and lost productivity. SIAS is also used as a watchdog here, warning the operator early enough so that he may react and prevent minor processing problems from turning into major production headaches.

Qualify the product for delivery. A third requirement is for the system to verify that the product meets the specifications in terms of surface quality. In its most

challenging form, this requirement means assessing the product's quality level to determine the application for which it is best-suited. To that effect, SIAS has developed a Coil Grading software application that allows to do this automatically based on the SIAS results captured on line. Improve defect knowledge and comprehension. Finally, the data collected by the system over several months of production promotes better understanding of defect origins or causes, helping to contain and even eliminate them.

Full support until final acceptance – and beyond

Siemens VAI Metals Technologies can provide an actual technical assistance to accompany the system's user throughout the tuning phase. In addition to providing a particular attention to the specific requirements of an individual project for a given user, this approach ensures a smooth knowledge transfer that eventually results in the end-user being completely autonomous and comfortable with using and optimizing the SIAS system. This approach has been applied by Siemens VAI SIAS successfully on numerous surface inspection projects, for both hot mills and processing lines. In each case, it has led to fruitful cooperation that has accelerated commissioning with controlled validation steps and visible progress.

Remote services

Introduced recently, Siroll^{CIS} PL SIAS is the online surface quality control solution of Siemens VAI Metals Technologies. SIAS technology offers reliable systems that are operational and running within days from installation. Based on expertise, experience and effective software tools, Siroll^{CIS} PL SIAS Remote Services provides customers with remote tuning, remote monitoring and maintenance, and remote assistance to include the adaptation to new product and/or process evolution. Over a fast and secure connection, Siroll^{CIS} PL SIAS Remote Services establish communication between onsite equipment and a database for checking the performance of the equipment with respect to the current target and measuring of detection and classification performance and improvements, as required.

Periodical monitoring and maintenance includes checks on settings and non-drift and back-up of parameters and configuration. For added convenience, the system supports screen-sharing with the onsite operator and telephone conversation promotes timely action, while detailed reports ensure complete transparency. ■

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Siemens supplies aluminum 3-stand tandem hot finishing mill to China

Fujian's Future

Driven by Asia's economic growth, China's demand for aluminum has come to exceed that of all other Asian countries combined. Siemens Metals Technologies has received an order from Chinalco Aluminium Co., Ltd. to supply the mechanical and electrical equipment for a new aluminum 3-stand tandem hot finishing mill. The author explains how this plant, which is being built in Fujian Province, will contribute significantly to Fujian's future economic development.

ROLLING & PROCESSING >



Siroll^{CIS} ALU – Solutions for aluminum rolling mills

Chinalco Ruimin Co. Ltd is part of the Chinalco Aluminium group, the largest producer of aluminum flat rolled products in China. Established in 1992, Chinalco Ruimin Co., Ltd., located in Fuzhou City, Fujian Province in southeast China produces mainly aluminum rolled semi-products, including sheets and coils. After 10 years' development, the company has become one of the leading aluminum fabrication enterprises in China and boasts a total production volume exceeding 100,000 MT with annual export of 40,000MT.

Chinalco products are currently exported to many countries worldwide. Ruimin is a special manufacturer of high quality aluminium strip and sheet for use in decoration; printing; packaging; electronics, electrical, and communication equipment.

Enhancing the key process component

The new 3-stand tandem hot finishing mill, for which Siemens is providing electrical and mechanical components, will be an integral part of a proposed aluminum 1+3 hot line, which is the key process compo-



Plant data

Finishing Mill

Ingot weight	max. 23,9 t
Transfer bar thickness	max. 40 mm
Exit thickness (last pass)	2,5 – 10 mm
Maximum width	1050 – 2250 mm
Maximum width (trimmed)	950 – 2150 mm

Coiler

Coiled dimensions	
Outside diameter	max. 2600 mm
Inside diameter	610 mm
Maximum coil weight	23 tons
Specific density 1	13.1 kg/mm

Product data:

Hot rolled aluminum and aluminum alloys 1XXX, 3XXX, 5XXX and 8XXX series

ment of a major plant expansion planned by Ruimin. The roughing stand and the vertical edger will be built by a local supplier with technical support by Siemens. Production of the first coil is scheduled for November 2009.

The finishing mill comprises a 4-high stand equipped with hydraulic automatic gauge control, E-block positive and negative heavy bending, work roll chock mounted brushes and ISV spraybars. Coiling equipment for multiple coiling passes, an edge trimmer with separate chopper, thickness/profile gauge

and strip temperature measurement are also being provided. The mill itself will be designed to roll a wide range of products and alloys, and will be capable of rolling over 370,000 tpy at widths up to 2.25 meters.

In addition to the mechanical equipment, Siemens is supplying all automation technology; the drive systems, utilizing Sinamics SM150 and S120 converters; and the sensors. The automation system comprises the basic automation, including the technological controllers, as well as operation and visualization equipment. Siemens will also supply the process automation for the complete hot line to ensure the highest standards in product quality. All automation components and systems are part of Siroll^{CIS} ALU, the integrated solution for aluminum hot mills. In addition, Siemens is responsible for commissioning and customer training.

Cutting-edge performance

The Siroll^{CIS} ALU solution has everything to bring aluminum rolling mills up to speed. This includes the high-power roll drives for higher throughput. State-of-the-art mechanical and hydraulic solutions optimize performance and operational efficiency. Online process models and neutral networks will enable customers to produce more accurately than before, and the proven automation solutions maximize the plant's end-to-end consistency, reliability, and operational safety.

Siemens VAI provides advanced mechanical actuators, electrical and automation control systems and applied process know-how to deliver gauge, profile, temperature and surface quality with the highest level of consistency. Roll stack actuators such as SmartCrown and DSR can be custom-selected according to the specific mill design.

Technological competence at Ruimin

Among the reasons for the Ruimin contract being awarded to Siemens are the company's technological competence, a significant number of reference projects for aluminium hot mills, and Chinalco's good experience with preceding projects. With this project, Siemens Metals Technologies continues to consolidate its leading position as a supplier of mechanical and electrical equipment for aluminum hot mills. ■

Main Benefits

Flexible, low-cost rolling of a wide range of products, even in small order lots

Tightest strip thickness, profile flatness tolerance

High surface quality

Most-advanced and innovative automation

Integrated occupational safety concepts

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Sustainable partnerships over the entire plant life cycle

Value-Added Services

SERVICE >



Downtime quickly leads to high costs – especially in the metals industry. To support operators in maintaining the availability and productivity of their plants, Siemens offers long-term service contracts that ensure quicker and better service.

Siemens delivered the electrical equipment and the automation solution for the world's first rolling-annealing-pickling (RAP) line to Outokumpu Oy, in the Finnish city of Tornio, and got the final acceptance in the spring of 2006. Because of the plant's complexity, the customer was very interested in entering into a long-term service agreement with

Siemens even at that early stage. In March 2007, the two companies signed the first service contract of the newly founded Metals and Mining Service & Support Center (MSC).

Service managers for all issues

Customers with a service contract have a service manager at the MSC as their personal contact who handles all concerns about their plant. The idea of providing a service manager for each customer was well received by all parties. The worldwide presence of Siemens allows the use of local staff. The service contract with Outokumpu soon involved colleagues from Siemens Finland, who began taking over jobs in the plant as early

as during the commissioning. The technical skill, short travel distance, and common language all make for perfect first-level support. The MSC in Erlangen handles all other levels of escalation and technological issues. The service manager coordinates all the necessary steps to help customers with their problems – quickly and competently. Together with Outokumpu, Siemens

designed optimizations and extensions and carried out the first modernizations within the scope of the service contract. Following full-scale preparations during the last summer shutdown, the main drive's torque converter was replaced, auxiliary drives with higher performance were installed, and the existing process computer infrastructure was replaced by new hardware. To guarantee high plant availability, upcoming tasks, deadlines, and workshops are confirmed and further joint actions agreed upon in twice-yearly status meetings.

Preferred care

So far, the contracted response and reaction time of two hours has reliably been met. A 24-hour telephone hotline is available (for service contract customers only), along with an e-mail address for the MSC. The service contract also guarantees the preferential treatment of all inquiries by Outokumpu, such as priority handling of spare parts requests, recommendations for exchange or follow-up components, and even coordination of subcontractor services. Outokumpu has clearly expressed its satisfaction with the

service contract's benefits in terms of plant servicing and preventive maintenance. After only one year in existence, MSC sees a bright future.

Laminar cooling project

In another project, Wuhan Iron and Steel (WISCO), China, has contracted Siemens to install a laminar cooling system for its No. 2 hot rolling mill, also automated by Siemens, within the scope of quality improvements to its plant. The MSC was involved from the beginning, from the project bid to planning to the project execution. The MSC service manager responsible for WISCO was appointed as the project lead to ensure that the team could benefit from the synergies arising from the service manager's knowledge of both the plant and the customer. The excellent order situation of the entire

steel industry put this project on a tight schedule. The commissioning engineers for this task were available for a specific time only. Thus, the commissioning could not be prolonged under any circumstances.

During the bidding process, one of the commissioning engineers performed a current-state analysis on-site to identify what support services should be provided by the customer. In the first weeks of commissioning, the requirements for successfully optimizing the cooling section were developed together with WISCO. Siemens specialists upgraded the process computer's mathematical models to state-of-the-art level and adapted the basic automation to this new software. The project lead regularly briefed the customer on project progress, open issues, and upcoming tasks.

Thus, it was possible to modify and optimize the plant step by step for the various types of materials. The successful optimization resulted in the desired improvement in quality and served as the basis for further collaboration between WISCO and Siemens Metals Services.

Migration concepts for automation computers

Another central aspect of the services provided by the MSC are migration concepts. In the last few decades, Siemens has used various computer platforms and architectures for automating processes. In the 1990s these were the DEC VMS platform and miscellaneous Unix derivatives such as Solaris x86, SINIX, and HP-UX. Common to all these projects was the SiiX-IS/SiiX-API universal control system. These projects relied primarily on proprietary hardware for which the manufacturer offered support contracts and spare parts for 10 years; some customers agreed to such contracts. Since 1999, Siemens has been committed to the Microsoft Windows platform as its standard environment. Now, the manufacturers' innovation cycles primarily decide the further development of the platform. Plants from 1990s often require migration solutions because of problems in obtaining spare parts or the discontinuation of manufacturers' support. For the customer, it is important that these migration solutions have minimum influence on production – enabling a safe conversion in a short time.

Last year Siemens acquired projects based on two different but complementary migration concepts. One of these projects was at ThyssenKrupp Stahl (TKS) and the other at Outokumpu Oy.

Migration at TKS in Bochum

The process control system of the wide hot strip mill at TKS Bochum, modernized by Siemens in 1997/98, was implemented based on the HP-UX 10.20 operating system and the SiiX-IS control system. Manufacturer sup- ➤➤

Main Benefits

Increased plant availability by early migration of system platforms

Improved spare part availability

Access to software updates via dedicated customer Web sites

Availability of optimization tools to improve plant performance on the basis of actual plant data

Availability of event-management tools that continuously monitor the status of automation systems to ensure timely reactions in the case of disturbances

Optimized spares management in the context of asset minimization and plant availability maximization



Laminar cooling system for hot rolling mill



Service for TKS in Bochum

>> port for the operating system ended in 2004, and support for the hardware will end in 2008. This makes it necessary to migrate the entire system to a new and future-oriented platform. To avoid production risks and minimize the effect on the existing system, Siemens offered the following solution to TKS Bochum and received the corresponding order in 2007.

The process computer will be migrated from the HP-UX 10.20 operating system to version HP-UX 11iv2, middleware components will be replaced by current software, and Siemens-supplied applications will be adapted accordingly. All the technological functions developed jointly over the years by the customer and Siemens will remain intact. At the same time, the project will enable the future extension of functions and ensure higher availability in the system in ever more complex structures.

With the new operating system platform, the current visualization solution, Si-IX-IS with the DataViews component, will no longer be available; a WinCC-based visualization will replace it. The calls for visualization from the applications will be adapted to the new architecture.

The entire interface with external communication partners will remain as is, as will the solution's functional and technological performance. In addition to the extensive reengineering of the existing system, the concept developed here will pave the way for future advancements. The commissioning is planned for July 2008.

Migration at Outokumpu Oy

The cold rolling mill with its coupled treatment line was commissioned in 2002 based on Windows NT 4.0 and Primergy Server hardware. The provision of spare parts for the Primergy E200 hardware was discontinued in 2007. The implementation of Windows platforms on Intel standard server hardware with a virtualization based on VMware was addressed in the scope of a research and development project for migration-package process automation. After successful internal tests involving the conversion of one non-customer specific process computer to a virtualized solution, all active process computers of RAP 5 were virtualized and converted in Erlangen. During a site visit one virtualized server ran on-site for one shift as an upfront test.

The solution's good performance and the positive outcome for this virtualized

computer of RAP 5 prompted Outokumpu to virtualize all six process computers during the summer plant shutdown. The process computers were converted in late August on-site and have since been running in production mode.

At the same time, two Level2 engineering systems were also virtualized, reducing the number of physical computers from eight to two. The use of VMware ESX in the entire plant has also boosted availability. The virtual computers now operating can be easily and quickly moved to different hardware. A future-proved solution was born. ■

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Diagnosis of complex industrial processes

Screening Production

The scope and complexity of industrial systems keep increasing to meet customer demands for product quality as well as manufacturing capability and efficiency. With this in mind, and working in close cooperation with Johannes Kepler University of Linz, Siemens VAI has developed a new and innovative approach for analysis of complex industrial processes.



>> **M**any industrial systems are often characterized by their complexity, reflected among other things in a large number of variables and parameters that must be monitored or adjusted. Manual monitoring of several hundred different process variables has become virtually impossible. Another problem, which is closely related to the complexity of systems, is that parts of the system are not familiar to process engineers who lack specialist knowledge of the complete process.

It is clear that the size of a technical system directly influences the complexity of the system, but it is not a decisive factor. For example, a system consisting of a thousand simple and isolated pipes for transport of a fluid can look like

a complex one, but, from the technical point of view, it is relatively simple. The situation changes if interconnections among different pipes exist. Interconnections basically mean that some parts of the process influence other parts. The number and intensity of these interactions directly determine the complexity of the technical system or of some portion of it.

An increase of complexity can lead to a decrease in knowledge about the system. It is not an uncommon situation that a part of an industrial process functions in a way that gives a satisfying output (for example, a product of good quality),

but at the same time the exact nature of the process (except of some basic knowledge) cannot be explained completely.

Increased complexity of the industrial plants and processes also causes additional problems to plant personnel, primarily to the personnel in charge of production and plant maintenance. Monitoring of the plant dealing with out-of-the-ordinary situations has become virtually impossible without adequate software support.

The quality of the measurement systems (plant or process variables measured and the kind of measurement equipment) directly impacts the clarity of the plant or process overview. In continuous industrial production plants of the steel and iron industries, for instance, numerous data channels are provided by the

automation systems, primarily for production and process control. This data contains valuable information, which can be put in good use, once extracted.

Process monitoring in real time

Faults in components and devices as well as failures in the production process itself can cause breakdowns of some components or even of the whole system. Measurement systems with increased complexity require algorithms for automatic data monitoring that can cope with a large amount of measurements of variables and rapidly changing data. The automation of diagnostic operations significantly shortens the time of the identification and isolation of potential or real causes of breakdowns over diagnostics done by human operators. Greater efficiency leads to better economic results.

Maintenance and reliability of complex systems

One of the most important goals in any production system is to keep production uninterrupted. Downtime is very expensive, and the costs of repairing damage to the plant caused by different malfunctions should not be underestimated. From the economical point of view, both monitoring and maintenance of the system are important. It is also important to minimize maintenance costs. In the traditional approach, maintenance is performed at a scheduled time to prevent failures, regardless of whether it is needed, for what capital and human resources must be allocated in advance. Still scheduled maintenance is totally inefficient in the case of sudden, unexpected failures of components.

Data-based approaches for modeling and diagnosis can be used for both the automatic monitoring and the predictive maintenance of a complex system, in order to increase system reliability and safety, improve system operability, extend operation time of the system, minimize maintenance, and maximize performance. Permanent monitoring of the system enables replacement of scheduled maintenance by predictive maintenance or Maintenance-on-Demand.

Maintenance-on-Demand means that, on the basis of a continuous monitoring of the system, maintenance can be conducted when the condition of components demands it. This approach can result in either increasing periods between two successive maintenances, reducing the maintenance costs, or in conducting maintenance after unusually short period of time, preventing serious damage to the system and saving exceptional repair costs.

An example from metallurgy illustrates the Maintenance-on-Demand approach: very important parts of a cold rolling installation are rollers. To keep the production process steady, the rollers are changed on a regu-

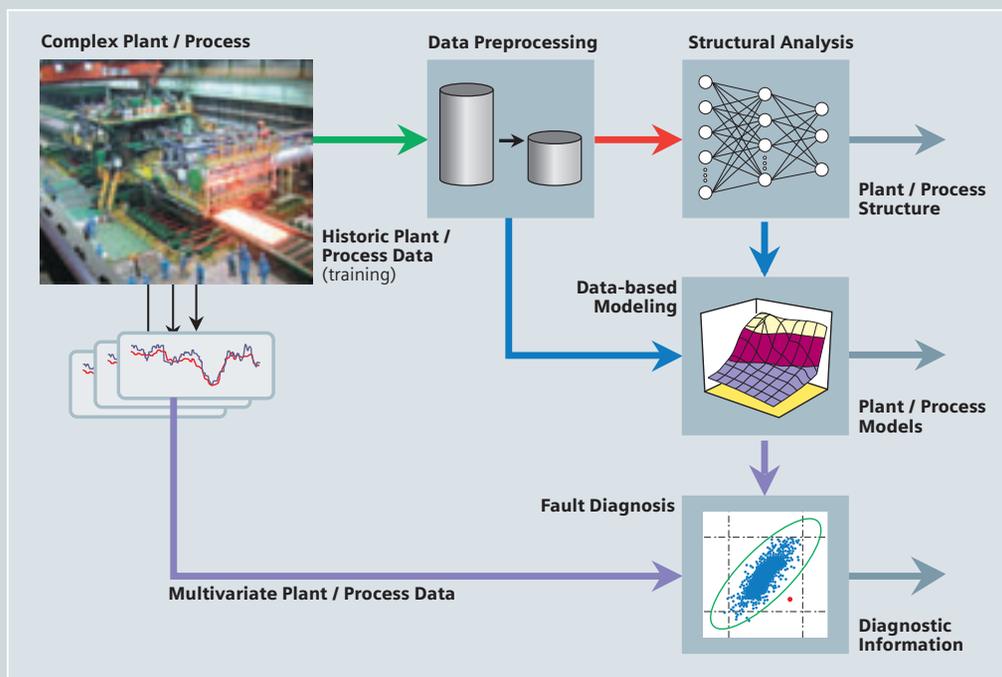


lar basis. The point of change is determined from experience (it depends on the actual rolling program and it is typically set after a certain “rolling distance”, usually expressed in tons of processed material).

It would be of great advantage to use a tool that can predict the point in time when change of rollers would be necessary, based on the different parameters observed. Predicting the point of change before scheduled change would help keeping the production process uninterrupted (i.e. reliability of the process is increased) while prediction of the point of change after scheduled change would increase degree of utilization of the rollers. In both cases, significant financial advantages can be achieved, because it avoids poten-

how to extract it, how to condition it, and how to use it.

The figure above shows the schema of data analysis of complex industrial systems. Historical measured data from a multivariate plant or process is used to model the plant or process. The data is conditioned in order to be reduced its volume, but with minimum loss of usable information. This conditioned data is then used to analyze the structure of the observed plant or process. The output from the structural analysis is used as one of the inputs for the modeling but is also the first result of analysis. The modeling step provides the models for the fault diagnosis as well as process or plant optimization, together with the results of structural analysis.



Schema of data analysis of complex industrial systems

tial breakdown of the system and idle production lines, and because the longer use of process parts reduces the costs for maintenance and spare parts.

Data based analysis of complex industrial systems

A process of automatic monitoring of complex systems relies on measurements, which can be used to automatically model and monitor the system utilizing data based modeling and diagnostic methods.

The availability of the measured process data is limited by the scope of the measurement system that accompanies the observed process. Since measurement systems often provide enormous quantities of measured process information, the problem is usually not the availability of information from the process, but

Fault diagnosis includes the fault detection and the fault isolation steps, to detect and localize faults in measured data, so that malfunctions in the observed process can be localized. Whether it is initiated online or offline, the fault diagnosis step involves measured data that are different from data used to train the system. After the fault diagnosis, the new data is very valuable in the adaptation of the existing plant or process models. ■

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Siemens VAI Honored by Posco

On the occasion of Posco's 2008 New Year's Reception on January 9 in Posco Center in Seoul, Korea, Siemens VAI received Posco's prestigious "Outstanding Supplier of the Year 2007" award "in appreciation for the reliable supply of Finex Plant and continuous casting ma-

chines and invaluable cooperation to Posco." All major foreign and local suppliers of Posco were represented, including Posco executives and purchasing management, etc. The award was handed over to Mr. Siegfried Kitlitschka (Corporate Account Manager for Posco), representing Siemens VAI, by Mr. Chung, Joon Yang, President, COO (Corporate Operation Officer) and CTO (Corporate Technology officer) of Posco. This was now the second time in three years that Siemens VAI received a supplier award from Posco. ■



Siegfried Kitlitschka (r) accepts Posco's "Outstanding Supplier of the Year 2007" award for Siemens VAI from Chung Joon Yang (l), Posco

Joint Venture for the Russian Market

Siemens and the Russian Uralmash Machine Building Corporation ("Uralmash") intend to establish the leading engineering and supply company for plant building in the metals and mining industry for the Russian market. Both companies signed a respective Memorandum of Understanding (MoU). "Siemens intends to increase its business in Russia and to use the joint venture (JV) as an engineering resource for its global engineering network in global markets", said Dr. Richard Pfeiffer, CEO of Siemens VAI Metals Technologies, Linz/Austria. "With the JV we support the Russian national strategy to develop the heavy machine and plant

building industry", said Nazim Efendiev, Director General of Uralmashzavod.

According to the MoU, 50 percent plus one share of the joint venture will be owned by Siemens. The JV will be jointly managed by Siemens and Uralmash. Uralmash will contribute to the JV the business, personnel and all assets of Uralmash Engineering ("UME"), sales, engineering and project management departments of other subsidiaries of Uralmash active in plant building for metals and mining customers. Siemens will contribute to the JV business potential for subsupplies to projects of Siemens VAI Metals Technologies in Russia and abroad, the license to use certain technology and process solutions such as pelletizing, sintering, blast furnace technology and cold rolling. Contributions of both parties to the JV will be defined in detail after due diligence. ■

More information

You can find further information and more press releases over our online portal at www.siemens-vai.com

Events: Upcoming Conferences and Fairs

- APR 01 – 03** THE IW BEST PLANTS CONFERENCE, Milwaukee, Midwest Airlines Center; <http://www.iwbestplants.com>
- APR 03 – 04** ÖSTERR. GIESSEREITAGUNG, St. Pölten, Wifi; <http://www.ogi.at>
- APR 09 – 12** METEF & FOUNDEQ, Brescia; <http://www.metef.com>
- APR 10 – 11** 2nd ANNUAL EUROPEAN CARBON CAPTURE & STORAGE, Berlin, Hilton; <http://www.events.platts.com>
- APR 13 – 18** STAHLRECYCLING – VOM SCHROTT ZUM STAHL, Mönchengladbach; <http://www.stahl-akademie.de>
- APR 14 – 15** STAINLESS AND ITS ALLOYS CONFERENCE, Pittsburgh, Marriott City Center; <http://www.amm.com/events/2008>
- APR 15 – 18** EXPOMIN 2008, Santiago de Chile; <http://www.expomin.cl/index.php?idi=8>
- APR 16 – 18** MINING WORLD RUSSIA, Moscow, Crocus Expo; <http://www.miningworld-russia.com>
- APR 21 – 25** HANNOVER MESSE 2008, Hannover, Exhibition Grounds Hannover; <http://www.honnovermesse.de>
- APR 22 – 23** 2nd STAINLESS / SPECIAL STEEL TRADE SUMMIT, Dubai, Renaissance Dubai Hotel; <http://www.cmtevents.com/eventschedule.aspx?ev=080418&>
- APR 23 – 25** AUTOMINING 2008 – 1st International Congress on Automation in the Mining industry, Santiago, Hotel Sheraton; <http://www.automining2008.com>
- MAY 05 – 08** AISTECH 2008, Pittsburgh, D.L. Lawrence Convention Centre;
- MAY 07 – 09** EUROPEAN CONFERENCE ON HEAT TREATMENT 2006 – Innovation in Heat Treatment for Industrial Competitiveness, Verona; <http://www.aimnet.it/echt2008.htm>
- MAY 07 – 09** INDIAN METALS 2008, Mumbai, Hilton Towers; <http://www.metalbulletin.com/events>
- MAY 11 – 16** 20th BLAST FURNACE COURSE, Hamilton, McMaster University; <http://www.mcmasteel.mcmaster.ca/Training>
- MAY 12 – 15** SEAISI 2008 Conference & Exhibition, Bangkok; <http://www.seaisi.org/>
- MAY 12 – 16** ABM 39th STEELMAKING SEMINAR, Estação Embratel Convention Center, Curitiba, Brazil; <http://www.abmbrasil.com.br/seminarios/>
- MAY 13 – 15** 17th INT. METALLURGICAL & MATERIALS CONFERENCE – METAL 2008, Hradec n. Moravici, Hotel Red Chateau; <http://www.metal2008.com>
- MAY 14 – 16** HYDROPROCESS 2008 – 2nd International Workshop on Process Hydrometallurgy, Santiago, Hotel Sheraton; <http://www.hydroprocess.cl>
- MAY 19 – 21** 6th INTERNATIONAL STEELMARKET AND TRADING CONFERENCE, Beijing; <http://www.mc-ccpit.com/smt2008>
- MAY 19 – 21** 9th EUROPEAN ELECTRIC STEELMAKING CONFERENCE, Krakow, The Jagiellonian University – Auditorium Maximum; <http://www.eec-2008.agh.edu.pl/>
- MAY 26 – 27** CONTINUOUS CASTING CONFERENCE – CCC'08, Siemens VAI, Linz, Design Center;
- MAY 26 – 29** METALLURGY LITMASH 2008, Moscow, Expocentr' Krasnaya Presnya Fairgrounds; http://www.metallurgy-tube-russia.com/cipp/mr/custom/pub/content,lang,2/oid,307/ticket,g_a_s_t
- MAY 28 – 30** ALUMINIUM CHINA, Canton, Guangzhou;
- JUN 01 – 03** 15th ANNUAL CRANE SYMPOSIUM, Pittsburgh, Sheraton Station Square; <http://www.aist.org>
- JUN 01 – 04** CHINA INTERNATIONAL STEEL CONGRESS, Shanghai, tbd;
- JUN 01 – 04** SCT 2008 – 2nd INT. CONFERENCE ON STEEL IN CARS & TRUCKS, Wiesbaden; <http://www.sct2008.com>
- JUN 03 – 04** CISMRC 2008 – CHINA INTERNATIONAL STEEL MILL ROLLS, Shanghai; <http://www.chinarolls.com.cn/>
- JUN 03 – 06** 11th METAL & METALLURGY 2008 EXHIBITION, Shanghai, Shanghai New International Exhibition Center; <http://www.mm-china.net>
- JUN 04 – 06** EUROPEAN CONTINUOUS CASTING CONFERENCE, Riccione; http://www.metallurgia-italiana.net/index.php?action=dettaglio_evento&id=32&evid=19
- JUN 04 – 07** MACHINE TOOL INDONESIA 2008, Surabaya; <http://www.allworldexhibitions.com/metal>
- JUN 08 – 11** SCANMET III, Lulea; <http://www.scanmet.info>
- JUN 10 – 13** 6th EUROPEAN STAINLESS STEEL SCIENCE & MARKET CONGRESS, Helsinki;
- JUN 15 – 18** INT. CONFERENCE ON NEW DEVELOPMENTS IN ADVANCED HIGH-STRENGTH SHEET STEELS, Orlando, Hyatt Grand Cypress; <http://www.aist.org>
- JUN 17 – 20** INT. CONFERENCE IN ADVANCED SOLIDIFICATION PROCESSES, Graz;
- JUN 21 – 25** 8th INT. SYMPOSIUM OF CROATIAN METALLURGICAL SOCIETY “MATERIALS & METALLURGY”, Sibenik;
- JUN 23 – 25** XXIII STEEL SUCCESS STRATEGIES (SSS), New York, Sheraton New York Hotel & Towers; <http://amm.com/events>
- JUN 23 – 26** 9th CHINA (GUANGZHOU) INT'L METAL & METALLURGY EXHIBITION, Guangzhou, China Import & Export Fair Pazhou Complex; <http://julang.com.cn>

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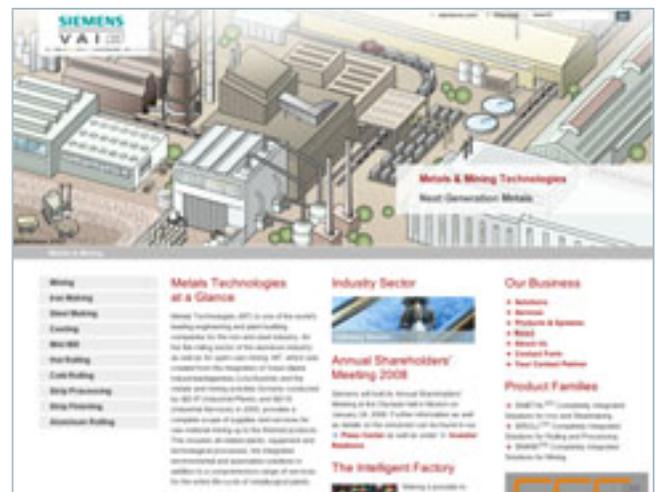
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