

metals & mining

The magazine for the metals and mining industries

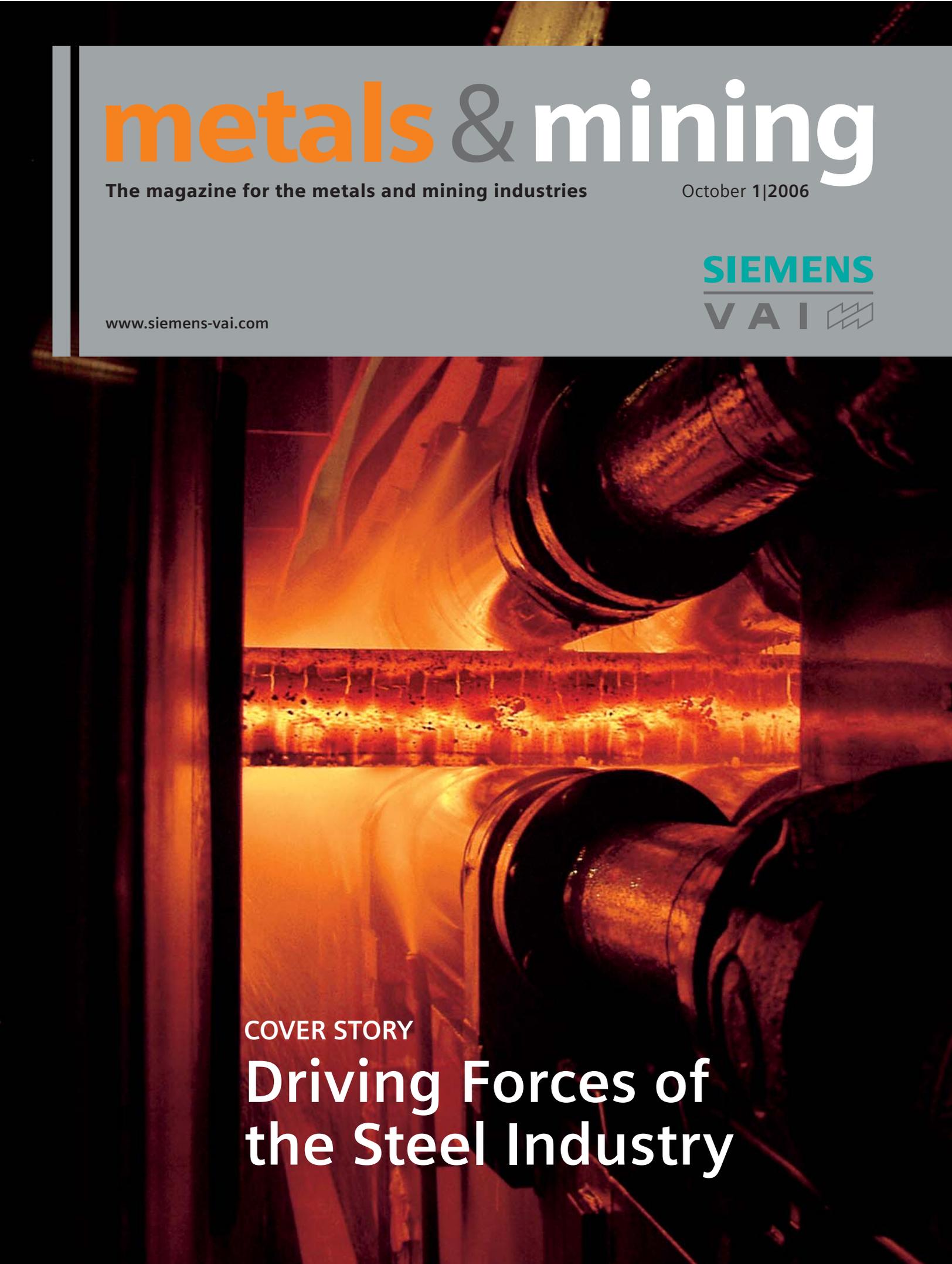
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SIEMENS
VAI 

COVER STORY

Driving Forces of the Steel Industry



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Editorial

Dear readers,

Developments in the metals industry are as dynamic as never before. The boom in the industry, emanating in particular from the “emerging markets” in Asia, has resulted in a continuous order flow for the sector. At the same time, many areas of the industry are currently also experiencing tremendous changes. Mergers and acquisitions are the order of the day. Newcomers are joining well-established suppliers in the market, thereby further increasing consolidation pressure.

At Siemens VAI, we are committed to playing an active and leading role in this market. We have therefore made it our objective to strengthen your competitiveness by pushing the envelope of technological development in cooperation with you. In other words, we are interested in anticipating future trends, rather than reacting to well-known facts.

Personally, I am fully convinced that an active dialogue is the best approach. Let us focus on and discuss the future demands of the industry together. In addition to close personal contacts, our new customer magazine serves to support this dialogue. It should provide stimulating insights, bring interesting opinions to the fore and draw upon the key themes which are driving the industry, everything from the mine to the finished product. This is what the title **metals & mining** stands for.

This first issue commences with a company profile of Siemens VAI. Industry insiders know VAI as a plant and process developer, and Siemens as an electronics and automation specialist as well as life-cycle partner. **metals & mining** introduces you to the added value that we – as the combined new company Siemens VAI – are capable of offering you with our tightly knit knowledge, customer contact, technological and services network.

Subsequent issues will further extend the magazine’s focus of the metals industry with broad-based interviews and articles – and, very importantly, also with your contributions, opinions and letters, which we very much welcome. I look forward to a lively dialogue on these issues.



Dr. Richard Pfeiffer
**President and chairman of the board
Siemens VAI**

Ladle Furnaces for Handan and WISCO

Siemens VAI received contracts from the Chinese steel producers Wuhan Iron and Steel Company (WISCO) and Handan Iron & Steel Company Ltd. (Handan ISCO) for the separate supply of a 300-t twin-ladle furnace. The combined value of these two projects is approximately six million euros. These large-size ladle furnaces will be integrated into a converter steelmaking plant of each producer to increase steel productivity as well as to assure a uniform steel quality for the subsequent continuous-casting step. Start-up of the ladle furnace at WISCO is scheduled for May 2007, and at Handan ISCO for September 2007. ■

Twin-ladle furnace from Siemens VAI



Series 8750 dragline with Siemens technology

Successful Partnership

Bucyrus International, Inc. and Siemens, who have worked together to supply heavy excavators to the surface mining industry for 30 years, have extended their period of collaboration for another ten years. Their most recent joint innovation is the world's first large walking dragline with a complete AC-IGBT (Isolated Gate Bipolar Transistor) drive system. This dragline also carries the first "D3" (Direct Drive Dragline) gearless AC hoist and drag drive system. Bucyrus and Siemens will continue working together to offer a comprehensive range of products for the technically demanding surface mining machine market. Thanks to the automation and electrical drive systems provided by Siemens, these heavy machines are more productive, require less maintenance, and have provided drive availabilities of higher than 98%. ■

Large Order from Russia

NTMK (Evrazholding Group, Russia) commissioned Siemens VAI with an order totaling 130 million euros for the renovation of the core equipment at the steel melt shop of NTMK. The goal of the investment is to increase production from a current 3.5 million to 4.2 million tons per year. In addition, NTMK will improve the steel quality and diminish pollutions. The specialties of NTMK are railway products and enjoy a very high reputation. Siemens VAI will supply four new converters equipped with state-of-the-art features, and will install a new material feeding line for converter and ladle charging. Siemens VAI will also integrate the electrical equipment and automation, technological control systems, instrumentation, MCC systems, variable speed drives, electric power supply and distribution as well as special electrical equipment. The start-up of the first converter is scheduled for the fourth quarter of 2007. Two converters will be started up in 2008, and the fourth converter in the second quarter of 2009. ■

Metallurgical Facilities

The Taiwanese steel producer Dragon Steel Corporation awarded Siemens VAI a series of orders for the design and supply of a new sinter plant, blast furnace and slab caster. These metallurgical facilities will be part of a new iron and steel works to be built in the harbor area of Taichung. Following the start-up of the works scheduled for December 2009, Dragon Steel will be able to enter the flat-steel market sector with a production capacity of 2.5 million tons of high-quality slabs per year. Siemens VAI headquarters in Linz/Austria will be responsible for the design and installation of the sinter plant, while Siemens VAI UK Ltd will engineer and supply the blast furnace and a 2-strand slab caster. ■

More information

Further information and more press releases can be found in our online portal at:

www.siemens-vai.com

Leading Market Position



VAI Fuchs supplied a 65-t AC EAF to Al Ittefaq/Dammam, Saudi Arabia, a plant of the Al Tuwairqi Group

Siemens has further strengthened its leading market position in the field of electric steelmaking with four new orders worth over 50 million euros. The VAI Fuchs GmbH, Legelshurst/Germany, a company of the Siemens Group Industrial Solutions and Services (I&S), received new contracts totaling over 50 million euros from steel producers in the UK, Saudi Arabia, Spain and Pakistan. "The reasons for the awarding of the new contracts were the innovative solutions offered for improved operating efficiency in electric steelmaking," stated Werner Auer, managing director and spokesman of VAI Fuchs. VAI Fuchs has been a frontrunner in the development of new electric steelmaking technologies for the past 35 years. ■

Meeting the challenge of change with innovative solutions

Driving Forces of the Steel Industry

Several factors are having a major impact on the overall development of the international steel industry. Steel producers are merging, trade barriers are coming down, and environmental regulations on CO₂ emissions and waste treatment are being tightened virtually everywhere. More fundamentally, steel producers are also focusing their attention on harnessing the forces that move the steel industry, such as its raw materials, production, costs, and human resources, for their benefit. Innovative technological solutions are the key.

In the international steel industry, there are a number of factors which are having a major impact on the overall developments and trends in this industrial branch.

These include:

- Continuing globalization and concentration of steel producers
- Increased worldwide competition resulting from deregulation and removal of trade barriers and tariffs
- Relocation of production sites for semi-finished products to strategic locations along the coast
- Tightening of environmental regulations with respect to emissions (e.g., Kyoto protocol) and the treatment of waste materials

In addition to these factors, steel producers must also focus on and respond to the main driving forces behind developments in the steel industry – as pointed out by the European Steel Technology Platform (ESTEP). These driving forces can be defined as:

- Raw materials
- Products
- Costs
- People

The driving force: “raw materials”

Over the long term, the margin between revenues and steel production costs is expected to narrow as the worldwide demand for limited raw material and energy supplies continues to increase, thus driving the costs for these in an upward spiral. One escape from this tightening revenue-cost shear would be the greater and direct usage of less expensive and more widely available raw materials such as iron ore fines. At the same time, the protection of the environment through the application of innovative process technologies which reduce emissions and wastes (sludges, dusts, CO₂), in combination with advanced recycling solutions that convert wastes into valuable products, will eventually become mandatory in the industry.

The driving force: “products”

A paradigm shift can be observed in the steel industry today in that companies are becoming less and less technology-oriented and more and more “value-enhancement” oriented. This is reflected by the efforts of producers to improve the quality and value of their products as exemplified by the development of new and

ultra-high-strength steels – a development, which is especially supported by the automotive industry. The creation of higher-value steel grades through innovative product development is an important step for maintaining and expanding existing markets, as well as for securing niche markets. Examples of new steel grades for special applications include dual-phase, TRIP (Transformation Induced Plasticity) and TWIP (Twinning-Induced Plasticity) steels. This paradigm shift is also seen by the efforts of producers to elongate the value-added chain in production through the increased installation of downstream facilities such as galvanizing and coating lines, as well as by the manufacturing of, for example, tailored blanks and auto-body parts where higher revenues can be obtained. The prediction, control and improvement of product quality is achieved by the installation of fully automated steel plants, beginning with the processing of the raw materials up to the dispatch of the finished products.

The driving force: “costs”

In addition to the production of higher-value products, the permanent reduction of costs is the second major lever which is applied by steel producers to escape the shear of decreasing margins between revenues and costs. This cost reduction can be realized through an improvement of business processes (investment strategy, organizational aspects, flexible and just-in-time supply, etc.), by measures to secure “Total Cost of Ownership” (TCO) in the supply chain through life-cycle partnerships with suppliers and service partners, as well as by the permanent optimization of production routes, equipment and logistics. Fast implementation of best practices (“benchmarking”) through the application of knowledge-management tools and the maximum employment of automation systems are further decisive steps towards reducing costs and increasing profits.

The driving force: “people”

The greatest asset of any company is its staff of highly qualified and motivated personnel. Therefore, aspects of health, “safety on the job,” working environment and training/education are becoming increasingly more important to ensure that plants are ideally operated and maintained for their entire service life. This also implies full automation and “roboterization” in dangerous working areas, such as in the melt shop and on the casting platform, as well as personnel networking and knowledge management to ensure continual improvements in plant operations and production. Modern idea management systems help to exploit the vast creativity potential and motivation of employees.

Innovative solutions in response to the driving forces

The key to handling the driving forces behind the steel industry is innovation – to be able to adapt fast to unpredictable changes in the market with the application of new technologies and business practices.

The successful transfer of innovative solutions into the steel industry, however, necessitates a close cooperation between the steel producer and the equipment supplier – a partnership which is not just limited to the engineering and commissioning phase of a new technology, but which also extends over the entire lifetime of the product.



Bruno Lindorfer

Head of Research & Development at Siemens VAI, Linz, Austria

Bruno Lindorfer studied mechanical engineering at the Technical University of Vienna, Austria. In 1981, he joined VOEST-ALPINE AG in Linz, Austria. Since 1998, he has headed the central R&D department of VAI, and is now responsible for R&D activities within the Siemens Industrial Solutions and Services department MT. Bruno Lindorfer holds several functions within Austria’s innovation promotion community, and is also a guest lecturer for innovation and technology management at the University of Linz and Leoben, Austria.

Siemens VAI, a plant builder and system provider for the steel industry for the past 50 years, offers a wide range of innovative solutions covering every step of the iron and steel production chain. Completely Integrated Solutions (CIS) are offered which combine Siemens electrical engineering and automation strength with VAI’s strength in metallurgical process technology, mechanical design and mechatronic package solutions. Siemens VAI is committed to being the market leader and trendsetter in metals technologies, from open cast mining and raw material handling to metallurgical technologies, solutions and services. Various examples of recent innovations are presented for the first time in this issue of **metals & mining**. Innovation is thus the bridge between the challenge of change and a golden opportunity for continued success. ■

More information

www.cordis.europa.eu/estep/home_en.html

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Siemens VAI taps into innovation potential

Creating Ideas

Siemens VAI prides itself on being a full-line supplier of iron and steel production facilities, in addition to rolling and processing lines for non-ferrous metals. This broad capability has been built upon a solid base of experienced multinational specialists, who have forged a global network of innovation partners that include lead customers, scientific institutions and suppliers. **metals & mining** spoke with Dr. Karl Schwaha, member of the board at Siemens VAI, on R&D activities, and on how innovation potential is promoted at Siemens VAI.

What distinguishes Siemens VAI from other companies with respect to R&D activities for the metallurgical industries?

Dr. Karl Schwaha: Siemens VAI is unique in that we come from a plant operating background, whereas other plant builders have their origin in a workshop background. This means that we have a more comprehensive overview and experience of the whole value chain at our disposal, enabling us to provide fully optimized solutions for plant-wide applications. As a consequence of our company's holistic philosophy, we have always focused on integrating the latest environmental and automation systems into our overall solution approach for the metallurgical industry. The development of new and improved technologies was the cornerstone of our company's foundation more than 50 years ago, and will continue to play a dominant role in our company's future.

Where is the focus of Siemens VAI R&D activities today?

Dr. Karl Schwaha: Up until about 5 or 6 years ago, the former company, VAI, had a major focus on the development and implementation of primary technological processes. Examples include COREX® and FINMET® ironmaking, medium-thin-slab casting and direct rolling, and also EUROSTRIP® direct-strip production. Today, it is our goal to be a life-cycle partner for our customers. This mindset now defines our innovation strategy, methodology and targets with a much more balanced innovation approach, also taking into account organizational aspects, procedures, internal process improvements and especially the driving forces behind market development. The best, yet not the only, example of our innovation predominance is in the field of continuous casting technology, where we are clearly the world market leader.

What do you see as the driving forces behind market development?

Dr. Karl Schwaha: Raw materials, costs, people and products. The priority of these forces, however, is different at different times. For example, innovative solutions with respect to cost savings are vital for a company when economic growth is slow, and innovation developments in connection with people-related matters such as safety, training tools and knowledge management can be more important at other times.

What new approaches to innovation are applied at Siemens VAI?

Dr. Karl Schwaha: One approach is that we focus on the development and application of technology packages which have a high customer benefit, because a package solution can address various factors and problems simultaneously. For example, the SMART® Segment allows strand thickness adjustments to be carried out automatically in combination with soft reduction during transient casting conditions.

A second approach is our emphasis on mechatronic design, which combines mechanical, electric, sensor and automation solutions within a single solution package. This is the basis for achieving an optimized total package ideally suited to the requirements of a producer.

Another approach is the parametric design in combination with 3D CAD. This means that, for numerous plant sections and components, the basic equipment design is defined in considerable detail. Then, depending on the special requirements of the customer, special software programs allow new, fully functional design solutions to be rapidly produced. In this way, proven solutions can be easily customized to the specific requirements of a customer.

Dr. Karl Schwaha

Member of the board
of Siemens VAI



Photo: Elisabeth Grebe

The employment of holistic procedures, design and engineering is a key element of innovation at Siemens VAI. This integrated approach minimizes interfaces between all process systems, their manufacture, operation and maintenance. Furthermore, many plant components feature decentralized intelligence and are equipped with their own processors and controls where process adjustments are locally made. These units are integrated via data communication with the centralized control center. All of these elements of innovation contribute to cost savings, faster project completion and an optimization of business processes.

How does Siemens VAI utilize the creative potential of its employees?

Dr. Karl Schwaha: Siemens VAI is proud to have a stable base of multinational experts who can bring in their experience and ideas from various sectors of the indus-

try. They also established a global network of innovation partners, i.e., lead customers, scientific institutions and subsuppliers. For our own employees, we implemented the VAIdeas idea-promotion system for continuous improvements at the company headquarters several years ago, which has since been rolled out to the entire Siemens VAI Group of companies.

The result has been an impressive increase in the number of ideas which have been of considerable benefit to Siemens VAI. In an independent assessment, Siemens VAI was ranked very high amongst European companies with respect to the generation, submission and implementation of actionable ideas. ■

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SINTERING**Intensive mixing and granulation system (IMGS)****Unsurpassed Homogeneity****Main benefits**

- No blending yards required
- Improved mixing quality and compositional homogeneity
- Increased sinter plant productivity
- Reduced energy, fuel and burnt-lime consumption
- Sintering of iron ores with high content of ultra-fine-grained material without negative effects on productivity, sinter quality and energy consumption

The raw mix preparation is one of the most important factors for assuring a consistent sinter quality, a low energy and fuel consumption, and a stable sintering process. A high sinter quality and plant productivity require not just a homogeneous raw mix composition, but also that every green agglomerate on the sinter strand has the same chemical composition and physical characteristics. Blending yards in combination with conventional mixing drums are not adequate to achieve this high degree of homogeneity, because the material behavior in the blending yard cannot be exactly defined, and the mixing efficiency of conventional mixing drums is limited. Furthermore, future iron ores will contain increasing portions of very fine-grained material, which cannot be properly mixed with the use of conventional mixing drums.

A highly effective solution to these disadvantages is the Intensive Mixing and Granulation System (IMGS) – the latest development by Siemens VAI in the field of sinter raw-mix preparation. Each raw material component is precisely dosed onto a conveyor belt in sandwich layers, and then mixed in the intensive mixer followed by granulation in a separate drum. Here, the green agglomerates acquire their final size and shape and can be covered with fine coke with a grain size of less than 1 mm. Sinter plant return fines serve as the nucleus for the granulation process and are charged to the mixed material conveyor belt before the granulation drum. With this solution, blending yards are no longer necessary, meaning immense investment, operational and maintenance savings!

Industrial application

The IMGS was first installed in 1998 in the sinter plant of the integrated long-product steel producer voestalpine Stahl in Donawitz, Austria. ■

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IRONMAKING

Hot direct-reduced iron (H-DRI) conveyor system

Efficient Hot DRI Transport

For the transport of hot DRI (Direct-Reduced Iron) from a direct-reduction plant to a melting facility (e.g., EAF), Siemens VAI has developed a special hot-conveyor system. Following the direct reduction process, hot (i.e., uncooled) DRI is directly discharged onto an enclosed, gas-shrouded, bucket-type conveyor belt. The material is elevated to a bunker system located above the melting unit from where it is dosed into the furnace at a temperature of up to 700 °C.

First Industrial Application

This system is already in operation at the FINEX® Demonstration Plant at Pohang, Korea, operated by the Korean steel producer POSCO. Here, hot-compacted iron (HCI) is transferred by the hot transport system from the compacting unit of the FINEX reactors to the top of a melter gasifier, followed by melting to hot metal. The

Main benefits

Shorter tap-to-tap times and higher production output

Reduced energy consumption during melting

Reduced electrode consumption in EAF

system will be installed in the FINEX Industrial Plant currently under construction, and is scheduled for start-up early 2007.

Industrial Application at the HADEED EAF Steel Works

Another application of this system will be at the iron and steel complex of the Saudi Iron and Steel Company Ltd. (HADEED), located at Al-Jubail on the eastern coast of



Hot-Conveyor System at FINEX® Demonstration Plant, POSCO, Pohang/Korea

Saudi Arabia. Approximately 200 t/h hot DRI from a MIDREX® direct-reduction shaft furnace will be transferred to a new 160-t AC EAF for the production of high-quality steel. Start-up is scheduled for 2007. ■

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LD (BOF)/STAINLESS STEELMAKING

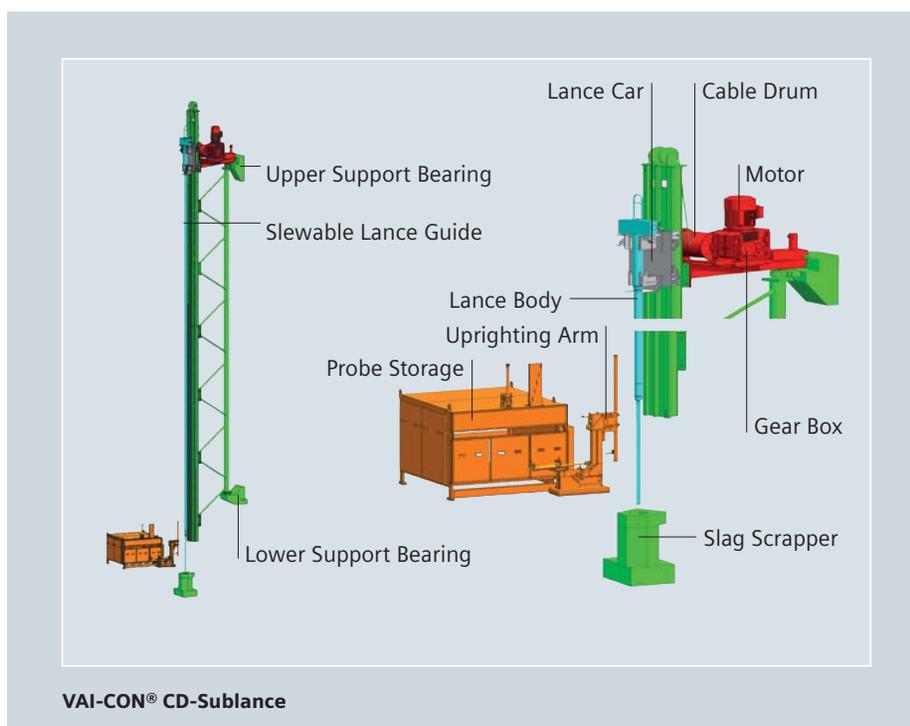
The VAI-CON CD-Sublance

Automatic Sampling and Measuring

The VAI-CON® CD-Sublance (CD = Compact Design) is an improvement over the classical VAI Sublance, and better meets the demands of the oxygen-steelmaking process in that the sampling and measuring steps are quickly, automatically and efficiently carried out. The unit consists of the following equipment items, systems and components:

- Lance body
- Automatic lance-coupling system
- Lance frame with drive and lance carrier

>>



VAI-CON® CD-Sublance

- >> • Storage magazine for 5 different probe types
- Manipulator for probe handling
- Slide gate in offgas hood
- Slag scrapper for lance

The sampling and/or measuring probe is automatically selected from the probe magazine, and is brought into the vertical position by means of a swiveling arm. Following alignment, the sublance is inserted into the probe, and then descends into the steel bath. After the measurement, the lance exits the steel bath and the probe is removed. All movements are carried out electro-mechanically or pneumatically without the need for more maintenance-intensive and expensive hydraulic systems. The drive is based on the use of a brake-gear motor and has an integrated brake. The motor is controlled by a frequency converter, and the lance frame itself can be swiveled or translatorically moved.

Lance-exchange time is kept to a minimum through the application of the well proven automatic quick-lance-coupling system from Siemens VAI. The coupling process for the water supply is done automatically, minimizing manual work for increased personnel safety.

Main benefits

- Fully automatic probe exchange and sampling
- Increased personnel safety
- Fast lance-exchange time (typically within 15 minutes)
- Fast resampling possible, if necessary
- Reduced converter tap-to-tap time
- Improved process control

The VAI-CON CD-Sublance can be seen as part of the Level II control system package. With this tool, the process control of the converter can be optimized and tap-to-tap times reduced accordingly. An advanced sublance system is an essential feature of all state-of-the-art oxygen steel-making facilities today.

Industrial applications

- Panzhuhua, China (2006)
- Alchevsk, Ukraine (2006)
- Baosteel Luojing, China (2007)
- Dnepkon, Russia (2007)

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LD (BOF)/STAINLESS STEELMAKING

The VAI-CON Joint system for stainless steelmaking converters

Faster Exchange Times

VAI-CON® Joint is an automatic coupling system which was developed for the process and shroud gas supply in stainless steelmaking converters with side- or bottom-blowing (e.g., AOD converter). The use of an industrially proven quick-coupling system eliminates the need for manual connection and disconnection of the tuyeres during regular converter exchange. Similar systems are already in operation in a number of plants for the water and oxygen supply line connections for top-blowing lances and sublances. It is based on the use of simple male and female connection parts sealed with O-rings. The

VAI-CON Joint system can be used for single media supply lines as well as for individually controlled multiple oxygen or shroud gas supply lines.

The relevant figure shows the installation of the unit in the disconnected state on an AOD converter with a horseshoe-type trunnion ring. The connection block is ideally positioned on top of the trunnion ring for easy access. The

Main benefits

- Greatly increased personnel safety through the automatic coupling of the media supply (oxygen and shroud gas)
- Increased converter availability, and thus steelmaking output
- Short return on investment



**LD (BOF)/STAINLESS
STEELMAKING**
The new VAI-CON Stopper
system

Longer Service Life

With more than 90 references worldwide, the standard VAI-CON® Stopper is well known and one of the most efficient slag-retaining systems in the steel industry. Nevertheless, Siemens VAI is permanently improving the system in order to increase its availability and reduce maintenance requirements. An important new feature is a quick-exchange mechanism which allows the VAI-CON Stopper to be replaced within less than 2 hours. The service life of the critical parts has also been increased so that the unit can be exchanged during a scheduled converter-relining period. Converter downtime for reasons related to the VAI-CON Stopper can thus be avoided.

This equipment itself is of the classical design, however, it is mounted onto the

converter on a frame with only 6 bolts. The connection of the gas supply is done automatically using the industrially proven quick-coupling system already installed in several plants for the media supply con-

Main benefits

Short exchange time possible within two hours

Automatic coupling of media supply

Increased unit service life allowing exchange during regular converter relining period

Thus, no converter downtime for VAI-CON Stopper-related reasons

nection in top-blowing lances and sublances.

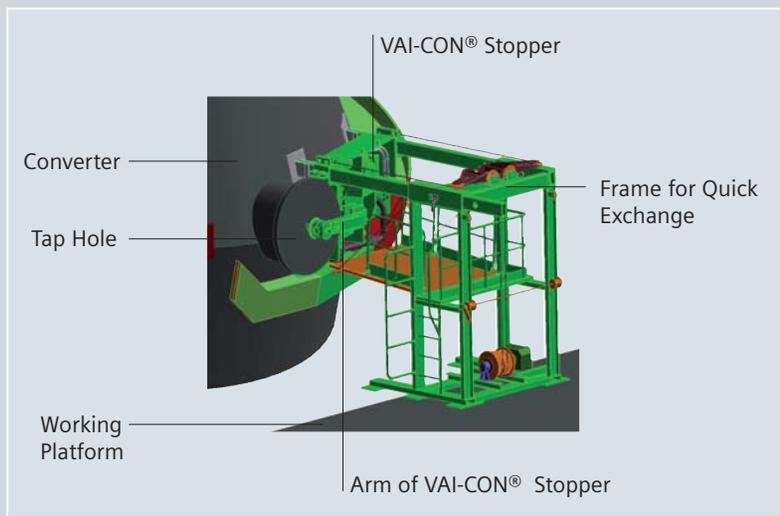
With the use of a specially designed frame, the VAI-CON Stopper can be easily and safely replaced. Thanks to the simple design of the connections, the unit can also be exchanged under hot conditions.

Industrial applications

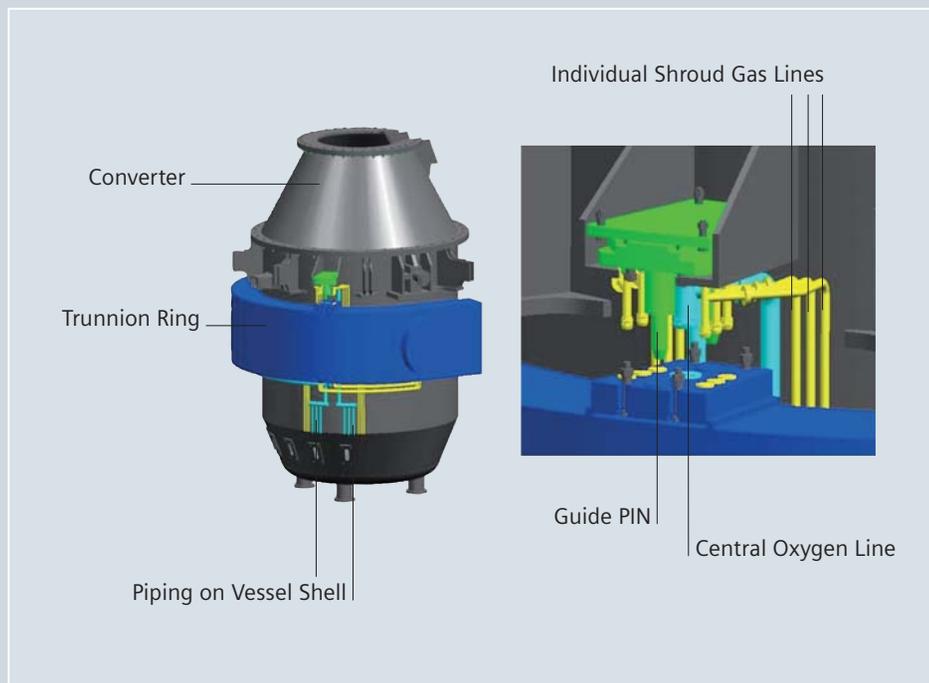
- ILVA Taranto (Riva Group), Italy
- Thyssen Krupp Stahl AG, Werk Bruckhausen, Germany

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VAI-CON® Stopper system with exchange frame



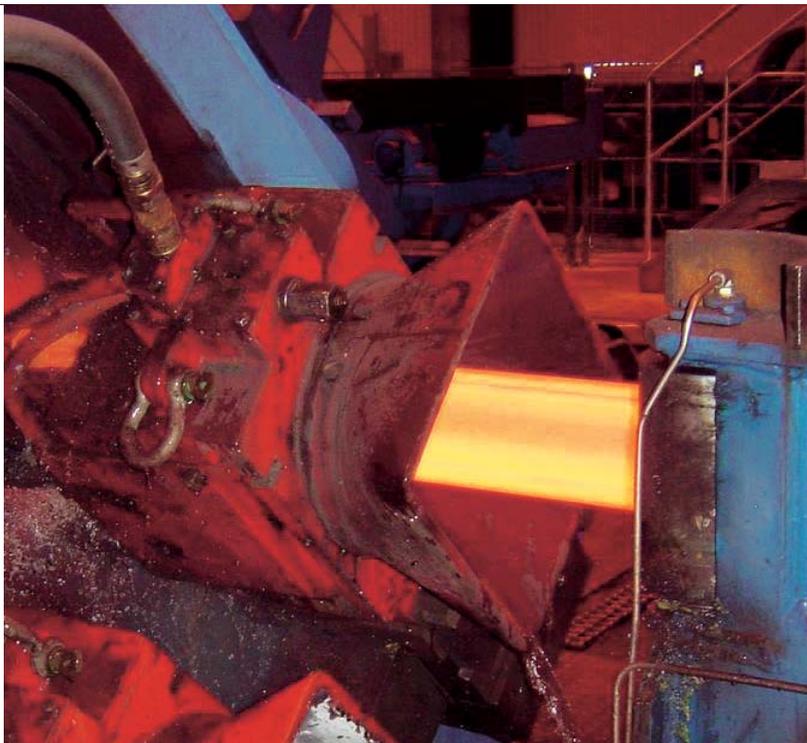
3D drawing of VAI-CON® Joint system for an AOD converter

VAI-CON Joint system is self-aligning, self-connecting as well as self-sealing during insertion of the converter into the trunnion ring when the converter is exchanged. Postinstallation of this unit on existing converters normally can be easily carried out with a minimum of modification work.

The described solution reduces the converter-exchange time by approximately 10 minutes for a notable increase in steel production.

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Main benefits

Easy and considerably enhanced pass-schedule calculation on the basis of material spread, mill load and bar temperature

Easy creation of set-up data for mill control and mechanical adjustments (e.g., guides)

Easy introduction of new steel grades and dimensions

No interference to ongoing rolling process due to offline creation of pass schedules

Increased production due to reduced mill set-up time for product-dimension or steel-grade changes

Improved repeatability of product characteristics and rolling process as the actual condition of the rolls and grooves is accounted for (no test billet necessary)

Improved long-product rolling with RollMaster

COVER STORY >

LONG-PRODUCT ROLLING

The calculation of pass schedules has never been so easy

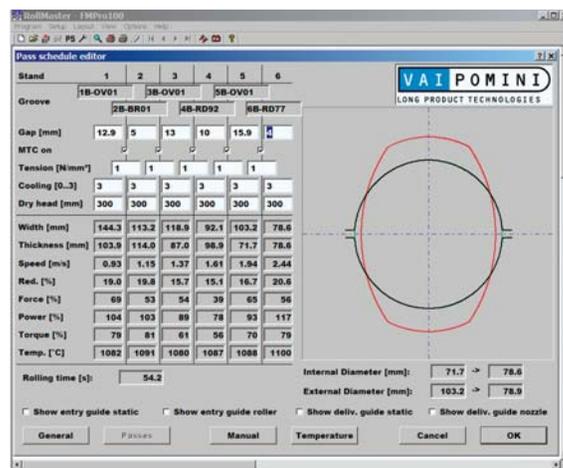
The RollMaster

The RollMaster from VAI Pomini is the ideal tool for creating and managing pass schedules for reversing as well as for continuous long-product rolling mills. This well-proven software tool supports the following:

- Easy computer-aided creation of pass schedules
- Calculation of material spread, mill load and the bar temperature on the basis of a database containing the properties of more than 200 steel grades and special alloys
- Accurate setting of the mill guides for product-dimension changes, including print-out of the set-up protocol
- Creation of the mill set-up with consideration to the actual condition of the rolls and grooves, etc.
- Easy management of all important data related to the mill grooves, guides and rolls, etc.

Additional modules are available for

- More comprehensive management of rolls and guides
- Maintenance and trouble-shooting support for the mill
- Automatic groove-wear compensation
- Extended monitoring and management of rolls and guides in the roll workshop with the RollShopMaster tool



Main window of pass schedule editor

Industrial applications

With more than 20 years of continuous development and improvement, the RollMaster represents a state-of-the-art software solution. As of June 2006 it has been installed in 17 mills. ■

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A Superior Coating Solution for Strip Processing Lines

A new heavy-duty, fully automatic hydraulic gauge-control roll coater known as DynaCoater® was developed by Siemens VAI engineers for the chemical coating of strip in galvanizing lines as well as for chemical and paint coating in color-coating lines. Featuring servo-hydraulic roll adjustments on the basis of dynamic force control, expensive spindle drives with their high maintenance costs and slow roll adjustments are a thing of the past. DynaCoater is characterized by its quick reaction times, highest mechanical precision and a world-unique closed-loop control system which operates on the basis of exact paint-thickness measurements. The tightest coating tolerances are achieved using computer-controlled coater presettings.

Industrial applications

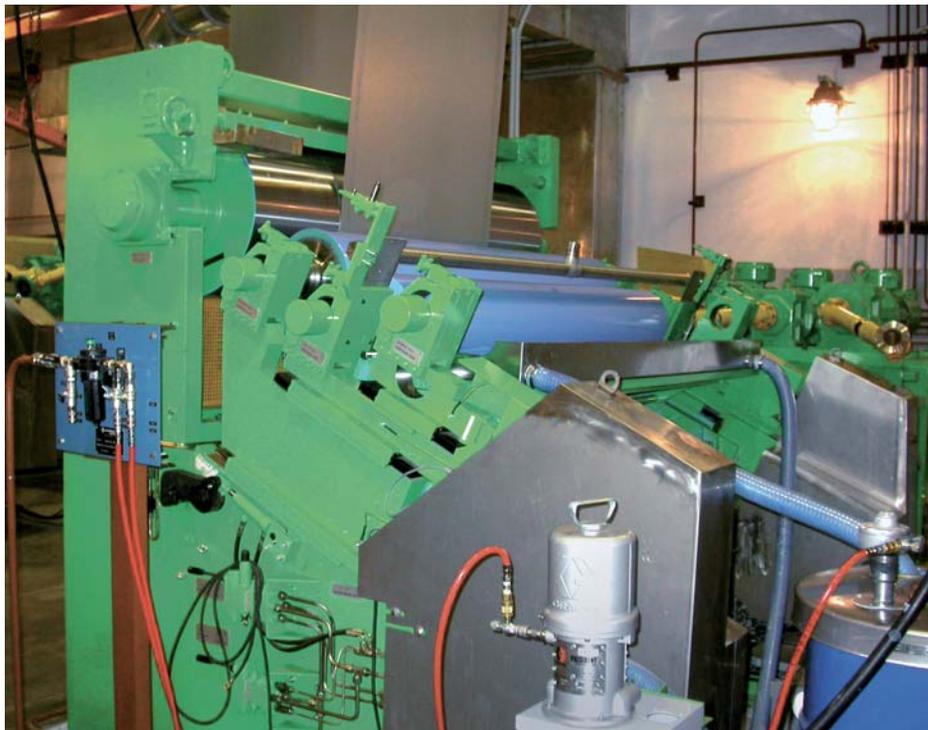
DynaCoater was installed for the first time at the new color-coating line of Magnitogorsk Iron & Steel Works (MMK) in Magnitogorsk, Russia, where it has been successfully operating since the line start-up on July 16, 2004. Since that time orders have been received from Mittal Steel, Poland (start-up: 2006), Benxi Iron & Steel Co., China (start-up: 2006), Kashira, Russia (start-up: 2007) and Bluescope Steel, Indonesia (start-up: 2007) ■

Main benefits

- Reduced paint consumption
- Improved coating quality and tolerances with computer-controlled coater presettings
- Reduced uncoated strip lengths at strip-splice passings thanks to automatic and rapid retracting and repositioning of the coating heads
- Dynamic compensation of roll eccentricity and roll-hardness deviations
- Less coating roll vibrations with the use of short cardan shafts
- Quick roll and paint change
- Return on investment within one year

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The new DynaCoater installed at the color-coating line of Magnitogorsk Iron & Steel Works, Russia



TUBE AND PIPE TECHNOLOGY

Mechanical joining of strip to produce structural beams and sections

DAVEX Strip-Joining Lines

DAVEX® is a linear and continuous cold-joining process in which flat strips, even of different thicknesses and materials (e.g., carbon and stainless steels, perforated sections and plastics), are mechanically joined to produce structural beams and sections. The joined sections can be used, for example, as supporting structures for electrical, heat-insulation and light-weight panel systems (with perforated web) in the construction industry, and has numerous other potential applications in the automotive, ship-building and rail-vehicle construction industries.

The width of the manufactured sections can vary from 25–180 mm for a total section height of

25–200 mm. Material thicknesses ranging from 0.6–10 mm can be processed. A DAVEX production line consists of the following process sections:

- Strip-preparation sections
- Grooving sections
- Cold-joining section
- Cutting section
- Run-out section

In order to ensure a continuous material supply, three separate strip preparation sections are foreseen; one for the lower flange, one for the upper flange (i.e., lower and upper strip sections of, for example, an I-beam), and one for the web. Each strip preparation



Strip accumulators for continuous strip supply

Main benefits

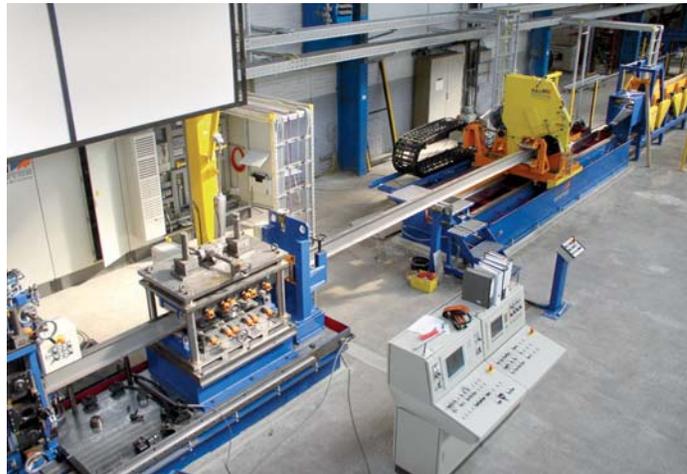
Continuous manufacturing process

Mechanical joining of strip without welding

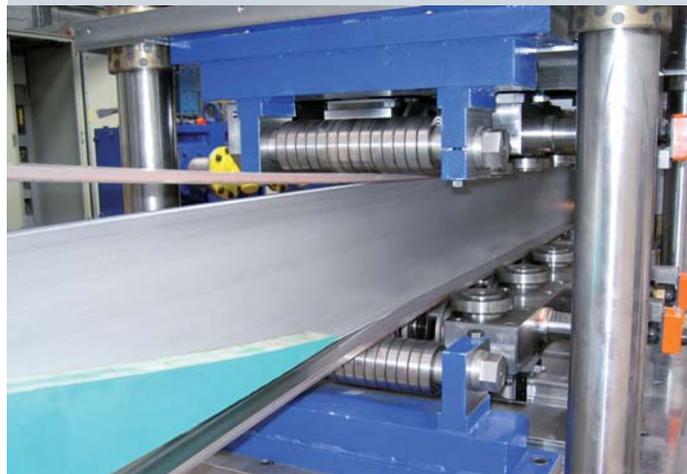
Joining of different materials and different thicknesses for the final section

Ideal for lightweight construction applications through optimized use of materials

Production of wide ranges of product dimensions



Flying-saw cutting section



Cold-joining section

section consists of a decoiler, a strip leveler, a strip-end shear, a welding unit and a strip accumulation system.

In the grooving sections, a groove is rolled into the two flanges and, at the same time, a contour is impressed in both edges of the web. This produces a form-fit joint when the three strips are joined. The impressed web is then positioned into the flange grooves. In the cold-joining section, a locking groove is rolled on both sides of the web into the flanges. In the cutting section, a flying saw with a tungsten carbide saw cuts the sections to the desired lengths which are then transferred to the run-out section of the DAVEX line.

Industrial application

In late 2004, a pilot plant with a line speed of 60 m/min for the production of DAVEX sections was started up by VAI Seuthe at ThyssenKrupp DAVEX GmbH in Gelsenkirchen, Germany. ■

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vatron New Continum system enables highly accurate metallic strip measurement

High-Precision Thickness Inspection

Presently, the thickness of metallic strips is usually determined by radioactive systems, mechanical-tactile gauges or by laser triangulation calculations. Radioactive-based thickness measurements are material dependent, and the degree of absorption for each type of material is different. In addition to the high investment, operation and recycling costs, long and laborious calibration and commissioning periods are necessary. Furthermore, the system sensors require radiation protection walls and are subject to strict safety regulations.

With mechanical-tactile thickness-measurement systems, the stylus is subjected to abrasion, and thus recalibration of the sensor is required from time to time. If the sensor is equipped with measurement rolls, vibrations induced by the workpiece can lead to measurement errors.

Laser triangulation sensors placed above and below the strip measure the distance to the upper side and lower side of the strip respectively. Knowing the distance between the sensors, the thickness of the strip can be easily calculated. However, if the measured distance between the sensors changes because of, for example, mechanical vibrations or thermal expansion, the thickness measurement value will be erroneous.

The new Continum system, in contrast, employs an optical one-sensor principle, and thus circumvents many of the disadvantages of the other strip-measurement systems, as outlined above. The method is principally based on the use of two lasers, but only one camera, continuously inspecting the strip from the side. Because of this visual, monoscopic approach, the measurement unit is not susceptible to oscillations or thermal expansion. Continum is thus a

brand new development designed especially for applications in the steel manufacturing and processing industry. This system is not just limited to steel, but can also be used to inspect aluminum, copper, brass,



Inspection of a rolled 2-mm-thick strip with continuum

bronze and non-metallic materials. Focusing again on steel, Continum can, for example, measure strip with rolled, ground, polished and even galvanized surfaces. With respect to the measurement accuracy, Continum achieves results similar to X-ray and isotope emitters, however, at a substantially lower investment cost. Should thickness deviations occur which are outside of acceptable tolerance values, an alarm signal is displayed, allowing corrective measures to be implemented (e.g., adjustment of the roller gap). Measurement results are stored for documentation and quality control purposes. Continum is available in a variety of versions, from a stand-alone sensor to a fully automated, plant-integrated solution.

Industrial application

Although Continum is a new product, it has already been successfully implemented at two sites. The first system was installed at pilot plant stations at voestalpine Stahl, and the second monitors the production of strip at Böhler-Uddeholm Precision Strip. ■

Main benefits

Fast and precise measurement of strip thicknesses

Material- and surface-independent measurements

Measurement accuracy of unit not susceptible to vibrations and temperature changes

Robust and compact design, easy installation in existing production facilities

No radiation safety precautions required

Highly attractive cost-performance ratio

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PLANT-WIDE SOLUTIONS

AIS SteelPlanner MSP optimizes capacity planning and production scheduling

Performing to Plan

The AIS Group (Advanced Information Systems), a subsidiary of Siemens VAI is a leading supplier of planning and scheduling solutions for the metals industry. In numerous projects implemented worldwide, the company's SteelPlanner® family of products has led to major improvements in the efficiency and performance of metallurgical plants through the optimization of capacity planning and production scheduling. Numerous references worldwide confirm the effectiveness and reliability of SteelPlanner solutions.

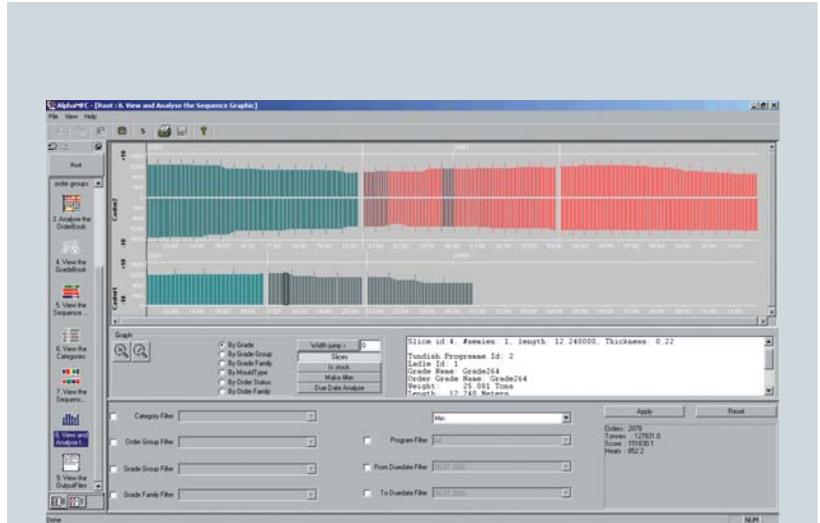
Optimized steel plant performance

High-performance steel plants require innovative IT solutions to ensure optimized production planning, scheduling and control of the entire melt shop. The AIS SteelPlanner MSP (Melt Shop Planner) is a unique and proven combination of MES (manufacturing execution system) and APS (advanced planning solutions) tailored to the needs of steel plants. The AIS SteelPlanner MSP also serves to integrate all processes taking place in the melt shop, including steelmaking, secondary metallurgical activities (ladle refining, vacuum degassing) and continuous casting operations.

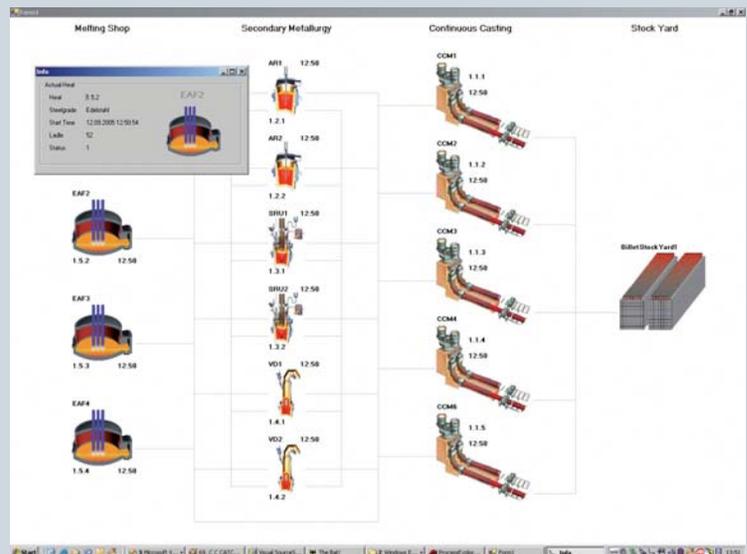
On the basis of the slab (or bloom/billet) orders (demand), which represent the order placed to the steel plant, MSP first calculates the optimum number and size of heats to be processed by the steelmaking facilities. In a second step, AlphaPlanner determines the most favorable casting sequence simultaneously for all casters and strands, taking into consideration the material flow constraints of the melting and secondary metallurgy units. The cutting plan for the slabs, blooms or billets is also defined.

Subsequently, the routing of the heats within the steel plant for a defined casting sequence is determined, and the optimized melt shop scheduling is performed, taking into consideration the capacities of the respective production units. The results are represented in the form of a Gantt chart, which also contains previous production data.

The Gantt chart offers even more. It is also a graphical editor which supports the scheduler to react fast to incidences occurring in the plant (online reactive scheduling). Based on the information from the shop floor, the MSP performs production tracking and control throughout the entire production process in the plant, which increases the transparency of the produc-



Example of an AlphaPlanner casting sequence



Melt shop overview

tion process and also serves as an important tool for quality assessment.

Slab/bloom/billet yard management functionality, featuring graphical yard maps in 2-D and 3-D representation, is also available with the MSP.

Industrial applications

The SteelPlanner MSP is currently installed in 20 steel plants worldwide. ■

Main benefits

- Efficient due date management
- Precise coordination of the material flow
- Optimized production performance and throughput
- Online and real-time production tracking
- Highest production transparency
- Professional support of quality assessment
- Multi-language capability and web-based information access
- Return on investment (ROI) repeatedly demonstrated within 3 – 6 months

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From slab to strip in an endless production line:
the Arvedi ESP process

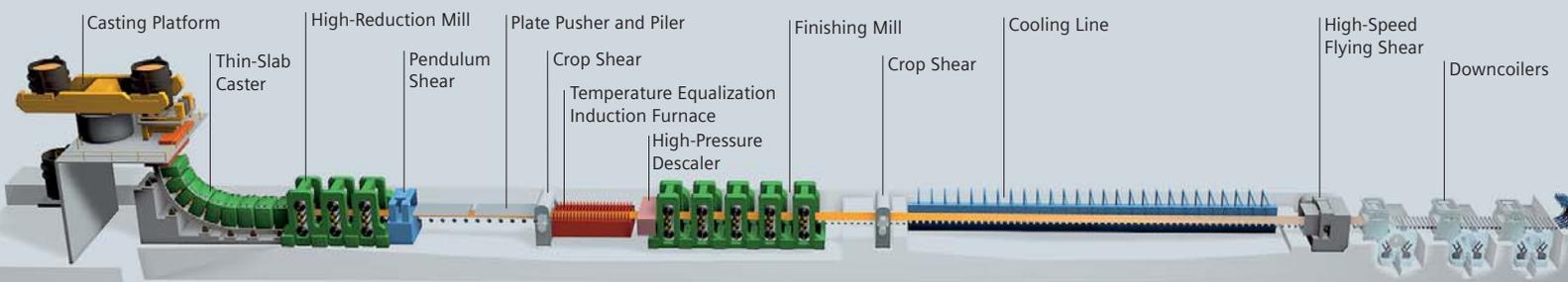
World Premiere

On August 1, 2006, a contract was signed between Acciaieria Arvedi (Arvedi) and Siemens VAI for the installation of the world's first Arvedi ESP (Endless Strip Production) line. This facility will be built at Arvedi's steel works in Cremona, Italy and will be capable of producing 2 million tons and more of thin-gauge hot-rolled strip per year in an endless process. Plant start-up is scheduled for 2008.

COVER STORY >



Thin-slab caster with integrated 3-stand high-reduction mill (existing ISP line)



Since 1992, a thin-slab-casting/rolling line has been in operation at the Arvedi steel works in Cremona, where high outputs of thin-gauge hot-rolled strip (down to 1 mm) are achieved on the basis of ISP (Inline Strip Production) technology. Arvedi recognized the technological and economical advantages of this line type and implemented a number of plant and process improvements. This led to the development of the Arvedi ESP technology, which will be capable of satisfying the increasing market demands for high-strength steels, new steel grades and ultra-thin steel strip gauges. The Arvedi ISP/ESP technology is covered by 20 patents.

Next generation casting/rolling process

This new generation of endless casting/rolling plants is distinguished by its unique capability to endlessly roll continuously cast thin slabs to a wide range of high-quality, ultra-thin hot-rolled products in strip thicknesses down to less than 1.0 mm. Depending on the steel grade and rolled strip thicknesses, the production capacity of this single strand line will be 2.0 million and more tons per year.

The new Arvedi ESP line will be comprised of four main plant sections in addition to infrastructural and auxiliary facilities. The first section consists of a thin-slab caster followed by rolling in a linked 3-stand high-reduction mill positioned at the exit of the continuous caster. As an important factor for the internal quality of the cast slabs, liquid core reduction will be carried out with Smart®-type caster segments prior to the high-reduction mill. In the second section, the temperature of the intermediate strip is equalized in an induction furnace for the requirements of finish rolling. The third section, comprised of a 5-stand, 4-high finishing mill equipped with the Siemens VAI SmartCrown® technology package, is designed to enable the rolling of strip to thicknesses between 12.0 mm down to below 1.0 mm at strip widths up to a maximum of 1,570 mm. The installation of advanced cooling systems at the exit of the finishing mill is the basis for the production of a full variety of steel grades. The fourth section consists of a high-speed flying shear and downcoilers where the

strip is coiled in weights of up to a maximum of 32 tons. The integration of state-of-the-art technological automation systems and packages – Siemens VAI can point to more than 20 references for the automation of thin-slab casting and direct-rolling plants – is a decisive factor for the confidence that all production and product quality parameters will be met. Plant start-up is scheduled for 2008.

Decisive advantages for profitable strip production

For the first time ever, an endless casting/rolling line concept will be implemented in which high-quality ultra-thin steel strip can be produced at high outputs and at favorable investment and operating costs. The highly compact line arrangement with a total length of only 190 m, and the direct linkage of the casting and rolling processes, means lower investment and operational costs in comparison with conventional thin-slab-casting and direct-rolling plants. With the line's capability to produce thin hot-rolled strip gauges, a subsequent cold-rolling process step will not be necessary for many strip applications, thus resulting in significant operational cost savings. Due to endless rolling operations, the production of strip with uniform and repeatable mechanical properties will be possible along the entire strip width and length. Full integration of all production facilities and the application of the latest technological packages are the basis for overall plant reliability, superior products and a high line output.

A newly formed joint venture company between Arvedi and Siemens VAI, Cremona Engineering Srl, headquartered in Cremona/Italy and equally owned by Arvedi and Siemens VAI, will introduce the Arvedi ISP/ESP technology to the market on a worldwide basis.

General layout of the Arvedi Endless Strip Production line

Main benefits

- Economical production of thin hot-rolled strip
- Significant cost savings
- High-quality steel with uniform mechanical properties
- High line output with a single caster line
- Low capital expenditures per ton

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Giovanni Arvedi: His Life, His Work, His Vision

Pioneer of Innovation

A landmark contract signed on August 1, 2006 between the Italian steel producer Acciaieria Arvedi and Siemens VAI marked the beginning of a mutual project to build the world's first Arvedi ESP (Endless Strip Production) plant. The new production facility will cast thin slabs that are then rolled into thin-gauge, high-quality steel strip in a continuous, endless process. Giovanni Arvedi, the driving force behind this revolutionary technology, comments on his company and the future of steelmaking in his own words.

My family has always been involved with metals; first in the mountains of the Trentino region of Italy and since 1838 in Cremona, where even now we have steel manufacturing and other industries. Out of conviction our work has always been directed towards the search for the best quality plants and products. We are convinced that the success of a company lies in the motivation of the persons involved in reaching the company's objectives.

The idea

It was in 1979, when our first melt shop and caster in Cremona was already producing, that I started to think about a way to industrially produce hot-rolled thin and ultra-thin-gauge strip at the same cost as thick gauges and with superior characteristics, so as to avoid subsequent cold rolling. I thought of making a new technology and a new process, exploiting the thermal energy of the liquid steel and creating in-line production. I was convinced that the slab entering the finishing mill should have the thinnest possible gauge in order to obtain a good ultra-thin strip. Therefore, the thinnest possible slab had to be produced and rolled immediately after continuous casting.

Its implementation

The idea turned into a research project which then developed into a batch process with the introduction of the Cremona Box to produce thin-strip gauges. After three years of studies and tests at the Cremona steelworks, Arvedi ISP technology came into being and the plant started up in 1992.



In our process, there were some problems to be solved; one of the biggest was the duration of the rolls. Nowhere in the world was there any experience of either inverse temperature rolling or low-speed rolling at high roll temperatures with the risk of fire cracks. I was left alone in a race against time and against the risk of my group going bankrupt. Together with my staff, we re-designed, re-built and installed new machines and adopted new technical solutions. Step by step,

safely controlling the thermal profile, we managed to achieve reliable and continuous production for up to 14 hours of continuous casting, producing high quality thin-gauge products. The Cremona plant, after years of study, research and experimentation, has brilliantly solved these problems. The single-line Cremona ISP plant now has patented new machinery, new technical and technological solutions with a new mold system, liquid-core reduction, cast-rolling, an induction furnace, a vertical Cremona box and rolling at constant speeds and temperatures; in short, it industrialized a new process.

The ISP process is highly reliable and produces a product mix that is unique in the world with excellent economic results. The first Arvedi ISP single-line plant with a table width of 1,300 mm has passed from a volume of 0.5 million tpy to over 1 million tpy, and in 2006 will produce 1.15 m tons. Today, the Arvedi group companies, with a staff of roughly 1,600 employees, manufacture products in the medium-high quality range, have modern plants with avant-garde technol-

ogy, highly capable management, balanced financial structures and good profitability. I contacted Siemens VAI, which led to a collaboration and the development of Arvedi ESP technology. The new Arvedi ESP plant will be a single line plant with a table width of 1,500 mm and will produce over 2 mtpy. With Arvedi ISP technology, a hot-rolled coil is obtained from the liquid steel in 15 minutes; with Arvedi ESP technology in only 7 minutes. A product yield of 97.5 % from the liquid steel to hot-rolled coils and a unique production mix are achieved, with 75 % in thin gauges between 0.8 and 1.5 mm without reducing the daily production capacity. No other plant in the world is able to obtain this mix and product quality.

Outlook

The Arvedi ESP technology has the same proven Arvedi ISP technology and, in connection with the increased continuous-casting speed, will allow maximum capital expenditure and operational savings. Hot-rolled strip will be produced with gauges, grades, widths and phys-



**Giovanni Arvedi,
Chairman of the
Arvedi Group**

“Seeing Arvedi ISP/ESP technology in production and creating good business for my group and for Siemens VAI will give me complete satisfaction. I am well aware of the tradition, reputation and importance of my technological partner, Siemens VAI. I am proud of our relations and of this project and I am committed to its rapid and positive realization.”



All photos: Acciaieria Arvedi S.p.A.

ogy, highly capable management, balanced financial structures and good profitability.

Making a steelmaker’s dream come true

The production limits of the current Cremona plant lie in the plant width of 1,300 mm, the limited capacity of the melt shop to produce liquid steel and the length of the continuous caster. The installation of a second ISP line would expand output, however, it would not im-

prove production performance in terms of capital and operational expenditures or product quality. The already competitive costs of the Cremona ISP plant will be further reduced by 30 %.

ical properties currently only obtained with certain cold-rolled strip applications. The production and rolling cycle for hot and cold strip down to 0.14 mm will undergo a historic development after the start-up of our ESP plant in Cremona, with enormous advantages in terms of revenues and positive repercussions for the environment. ■

Introduction of twin-station RH vacuum degassing plants

Better Steel, More Products, Higher Output

Steel mills are increasingly turning to vacuum degassing technology to produce higher quality steel, expand their product range and increase output. VAI Fuchs has brought significant advancements to the vacuum degassing process, including the introduction of twin-station plants that significantly boost production capacity.

IRON & STEEL >



Since their development in Germany in the 1950s, RH (Ruhrstahl Heraeus) plants – or vacuum circulation plants – have been used in the steel industry to improve the quality of steel and to increase the range of steel products. Today, the installation of degassing units within the steel shop has become a standard feature of a modern steel mill, particularly for the production of steel used in the automotive industry, for oil and gas transportation, in the construction industry, as well as for shipbuilding and wires.

Over the years, the RH process has undergone continuous development, including the addition of a top lance to promote forced decarburization and chemical heating. Also, to increase the productivity of RH plants and to reduce the total treatment time, the diameter of the RH vessel and snorkel have been enlarged, the argon flow rate increased, and the evacuation time of the vacuum system reduced.

VAIFuchs has introduced a number of developments in vacuum degassing technology – in particular, the design of RH plants as twin-station treatment facilities. This plant layout, in combination with the use of quick-exchange vessels, can significantly reduce the loss of production time due to ladle transfer, vessel exchange and snorkel maintenance. Although production rates depend on the steel grades to be treated, more than 40 heats per day are possible with a twin-station RH plant.

Twin-station design

A twin-station RH plant consists of two treatment stations connected to one vacuum pump and one common alloying system. A multifunctional T-COB (Technometal Combined Oxygen Blowing) lances is installed at each treatment station. This performs the tasks of oxygen blowing for forced decarburization and chemical heating, oxygen and natural gas injection for vessel-

refractory heating, as well as the removal of skull following RH treatment.

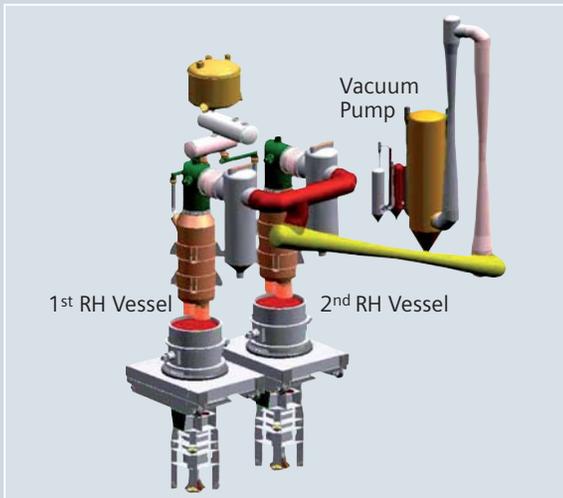
In order to effectively and quickly carry out snorkel maintenance, the plant has a separate service car equipped with an integrated gunning machine. The service car can be positioned directly below the RH vessel at the treatment station. Snorkel deskulling is generally executed every five to eight heats.

Quick exchange vessel

To facilitate the vessel exchange using the shop crane, each RH vessel is mounted in a vessel transfer car. During vessel exchange, the vessel transfer car moves to the vessel exchange position after lifting the top of the vacuum vessel. The shop crane places the vessel into a maintenance stand at the relining area, and

Ready for next heat

The treatment time in the first RH vessel starts with the transfer of a ladle to the RH treatment station. After a sample is taken, the snorkel is immersed into the steel bath. During these steps, the vacuum pump is still in operation at the second vessel to complete its metallurgical tasks there. After the completion of vacuum treatment at the second vessel, the vacuum pump is immediately switched to the first vessel for evacuation, and to conduct decarburization and degassing of the first vessel. In the second vessel, the ladle is lowered and transferred to the lift position. This is followed by maintenance of the snorkel in the second vessel until the next ladle comes for treatment. This phase can also be used to remove skull in the vessel, or to hold the temperature until the next heat. After the completion of the



Schematic layout of a twin-station RH plant



Cycle of a twin-station RH plant

takes the new preheated vessel directly back to the vessel transfer car. After placing the vessel onto the vessel transfer car, the utility connections (argon, bottom

cooling air, thermocouple, etc.) to the vessel are established by means of quick couplings. The vessel transfer car then moves the vessel into the treatment position and the T-COB lance heats the refractories to the necessary temperature for degassing operations. A vessel

change is completed within 1 hour, compared to about 12 hours in a conventional replacement system. This short exchange time supports high availability of the RH vessel and ensures continuous steel production.

vacuum decarburization and degassing processes in the first vessel, the vacuum pump is again switched to the second vessel. The treatment station of the first vessel is now ready for the next heat.

First industrial applications

Currently, four twin-station RH plants with quick-exchange vessels are under construction in China for the production of several steel grades, including ultra-low-carbon steel, pipe steel, ship steel, weather-proof steel and automotive steel. The clients are Maanshan Iron and Steel Co. (300 tons), Taiyuan Iron and Steel Co. (180 tons), Nanjing Iron and Steel United Co. (150 tons) and Jinan Iron and Steel Co. (150 tons). ■

Main benefits

- Improved steel quality
- Increased product range
- High outputs of up to more than 40 heats per day
- Reduced processing costs

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Upgrading the power supply for the arc furnace system at EWS

More Power

Edelstahlwerke Südwestfalen GmbH is planning to expand the capacity of its Siegen/Geisweid works from 450,000 tons per year to 600,000 tons per year. One of the measures to achieve this goal was to improve the performance of the furnace transformer and increase the arc voltage in the electric arc furnace. Siemens handled the upgrading of the transformer along with the assembly of a new furnace switching system and subunits.

At its Siegen and Hagen sites, Edelstahlwerke Südwestfalen GmbH (EWS) produces various grades of steel in state-of-the-art production plants: high-quality building steel, stainless steel, acid-resistant and heat-resistant steel and tool steel. The company's primary customers are the automotive, mechanical engineering and tool industries. Together with the Witten-Krefeld stainless steel works, the company belongs to Schmolz + Bickenbach Edelstahl GmbH, a subsidiary of Swiss Steel AG. The group is one of the world's largest producers of long products in the steel types mentioned above.

Growing worldwide demand

At the Siegen/Geisweid factory, EWS operates an electric arc furnace with a tapping weight of 140 tons for low- and medium-alloy steel as well as 120 tons for high-alloy steel. To meet the growing worldwide demand for high-grade steel products, the company decided to increase the capacity of the steelworks from 450,000 tons per year to 600,000 tons per year. To enable the factory to meet the new requirements, Siemens was contracted to deliver and modify the power supply for the EAF in April 2005. The replacement of the old furnace transformer with a more powerful model required the use of a step-down transformer connected



SIVAC-X furnace switchgear with the extendable 2500 A 3AH4 vacuum furnace switch

before the new furnace transformer, both with a power of 105 MVA. This transformer is connected directly to the 110-kV power supply network and supplies the 30-kV input voltage necessary for operating the furnace transformer. The new furnace transformer replaces the previous transformer of the arc smelting furnace, which had a rated power of 75 MVA. The higher power rating of the new transformer and its higher secondary voltage provide longer arcs in the furnace, and thus allow an increase in production of 30%. The required secondary voltage can be set using an on-load tap changer. A special feature of this furnace transformer solution is that the integrated (built-in) series

reactor can also be set using an OLTC. This stabilizes the arc and reduces the impact to the grid.

The plan for increasing the plant's capacity involved expanding the 110-kV switchgear and laying a new 110-kV VPE power cable. The scope of supply also included the installation of a new furnace switchgear, the replacement of the old furnace transformer and its storage. Also, Siemens was responsible for adapting and extending the plant protection system, as well as other components of the plant such as bus bars and the camera system.

Tight timeline

The time schedule for the conversion of the plant was very tight and had to be planned in detail, since most of the work had to be carried out during regular production without affecting it. Only the plant's summer shutdown (a maximum of 20 days) and Christmas shutdown (9 days), in addition to the regular eight-hour maintenance shutdowns once a week, remain production free for the technicians. Additional production loss was not acceptable. This was an ambitious aim because the new plant was to be connected and running at full capacity without a noticeable ramp-up period, slated for the beginning of January 2006.

On-schedule delivery and conversion

At the beginning of August, Siemens delivered and installed the 110-kV power cable to connect the switchgear and the new step-down transformer, and the new protection with the existing plant protection system. The specialists commissioned the cable during production. In November, during production, the team began the installation and commissioning of the step-down transformer, the furnace switchgear, the unit's copper bus bar, and the protection and interface cabinet for the exchange of standard process data. The delivery, installation and commissioning of the furnace transformer and related equipment around Christmas shutdown required special attention. Snow and ice affected the heavy vehicle transport to Siegen, disassembling the old furnace transformer and erection of the new furnace transformer by means of an erection scaffold and the overhead crane demanded maximum concentration from all of those involved. After short tests in early January, the plant was connected and the first smelting took place on schedule. As from there, the power of the furnace transformer was raised step by step to the new ratings, improving the melting time and quality to approach the planned capacities. ■

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Characteristics of furnace no. 1

Product mix of 80% reinforcing bars, 20% SBQ grades

Average 52 min. tap-to-tap time

Tapping weight of 73 mt

Three-bucket operation

Burner system with multi-point carbon injection

Capacity of transformer was not fully used (75 MVA)

Detecting foaming slag with an innovative method

Slag Detective

Effective detection of foaming slag in electric arc furnaces is an important requirement for steel plant operators all over the world. A variety of methods, including FFT analysis of the electric current or directional microphones, have proven unsuccessful in detecting the foaming slag height, making it impossible to complete the automation of the EAF process. Until now, that is, according to the authors who outline an innovative new multi-dimensional detection method in this article, and which was originally delivered as a paper at the CISA Conference in Beijing in April 2006.

A serious rail accident occurred in northern Germany involving an ICE high-speed train in 1998. Over 100 people died, underscoring the horror of the event. The cause was traced back to disintegration of a wheel brought about by cracks in the material. The risk of such a defect occurring again led to a pioneering development at Siemens. A set of measuring methods and sensor technology were developed on the basis of structure-borne sound, with the aid of which changes in the wheel microstructure or the formation of cracks can be detected (“heard”) during train operation. At the Siemens Industrial Solutions & Services Group (I&S), the idea emerged that this sensor technology could be used to detect the foaming slag height in an electric arc furnace. A partner was found for a series of experiments: the Lech-Stahlwerke GmbH in Germany. In February 2005, research and development was launched to investigate structure-borne sound detection. Objectives included the determination of the feasibility of vibration sensors and a comparison with other methods (FFT current analysis and directional microphones).

Straightforward testing procedure

Extensive tests were performed at Lech-Stahlwerke on furnace no. 1. The experimental setup involved the use of two sensors in the development phase. Vibration sensors were attached to the furnace panel at Phase 3 and Phase 1, with an adapter plate welded to the panel. In test series 1 (there were 4 series altogether), the type of sensor was also investigated, and one type chosen. A directional microphone was also set up to investigate this methodology. A high-resolution digital camera was mounted on the shop wall with a view through the lance manipulator, solely for verification purposes.

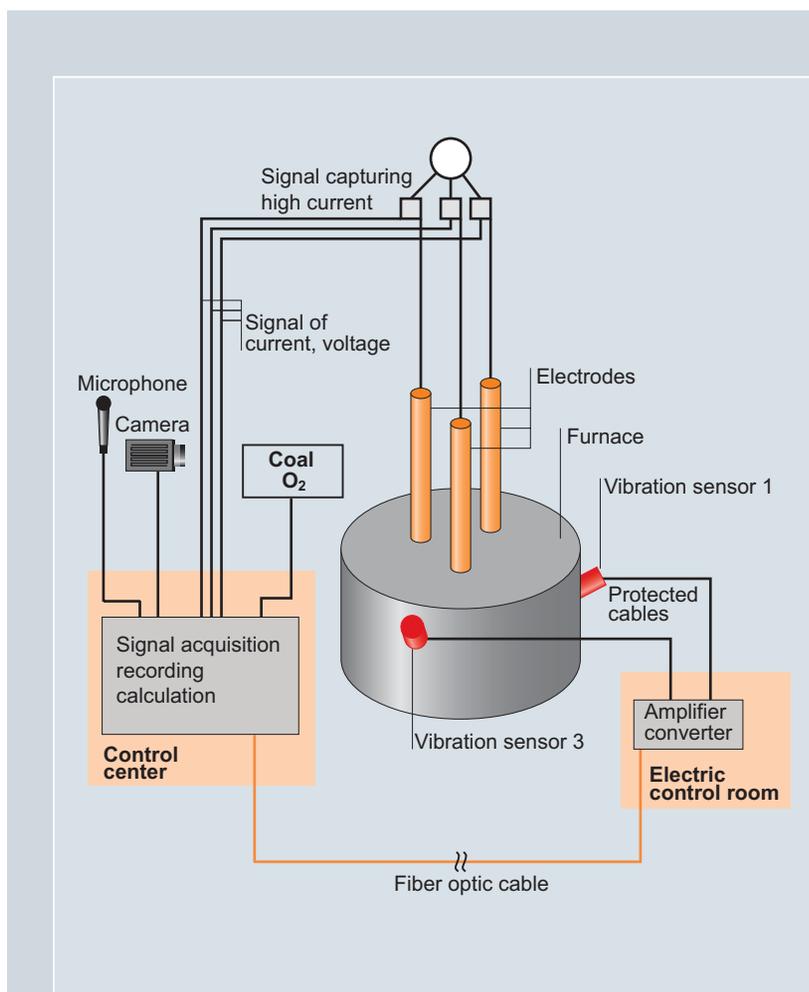


Fig. 1 Measurement system

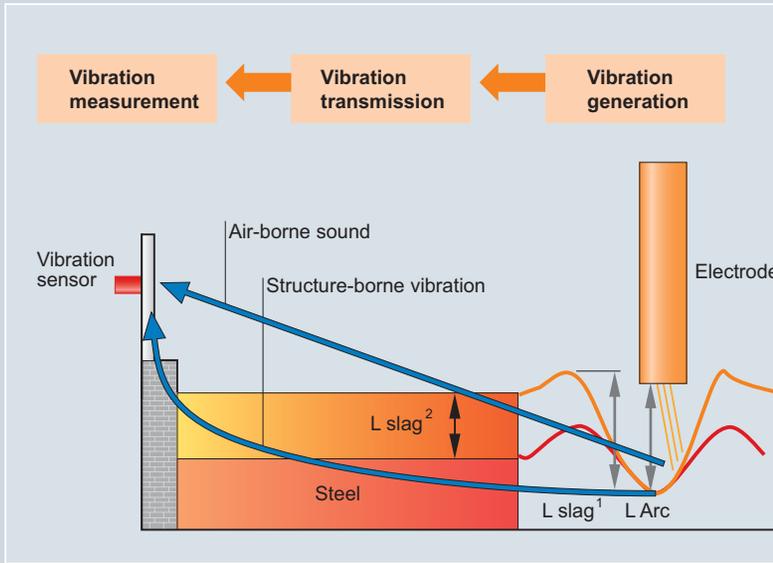


Fig. 2 Principle of evaluation and the transmission of sound/vibration

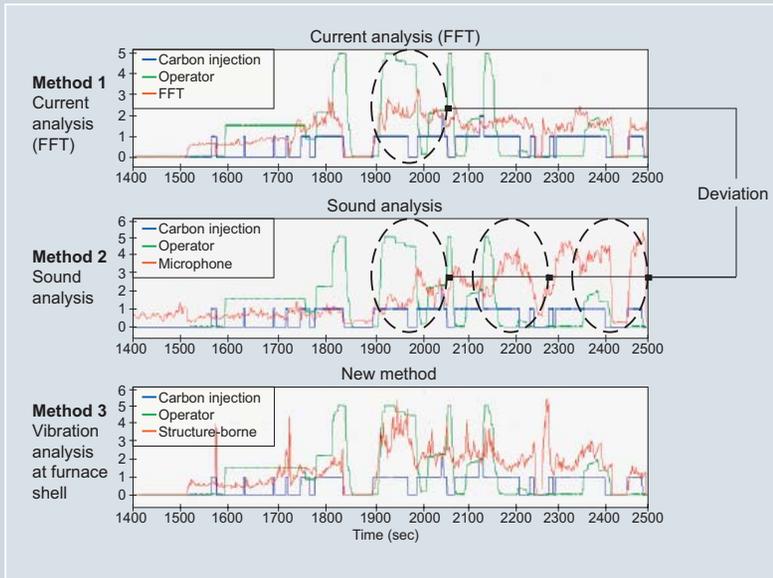


Fig. 3 Comparison of methods: foamy slag phase

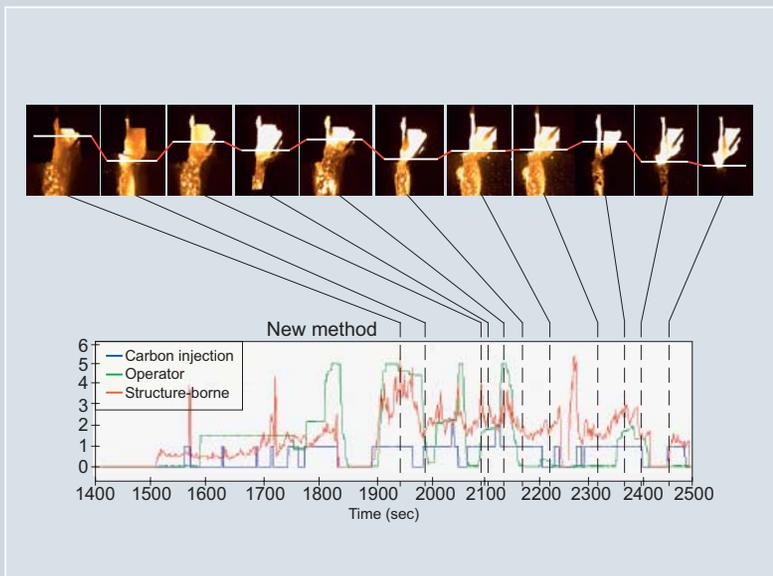
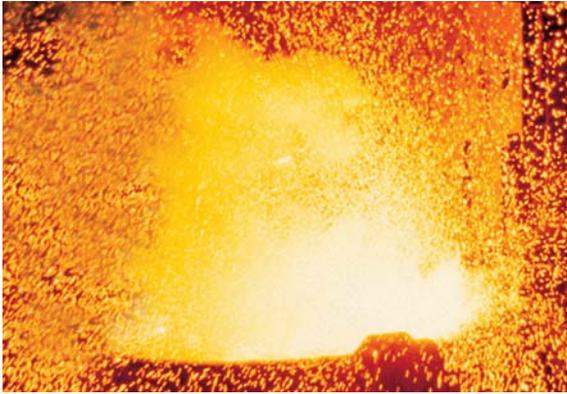


Fig. 4 Comparison of the camera view with calculated curve



>> In addition to the measuring instruments shown in figure 1, the current signal of the AC closed-loop electrode control system was monitored to investigate the FFT method, which is most widely used and commercially available. Data was recorded at the furnace control center, and evaluation carried out offline at Siemens Corporate Technology. In test series 1 and 2, only one sensor at phase 3 was examined. In the last two test series, a sensor was added at phase 1 to determine foaming slag heights in the furnace. The electric arc serves as the acoustic source for determining the height of the foaming slag (Fig. 2). As the generation of the sound cannot be measured at its source, the current signal is used as a reference signal for the subsequent evaluations. The signal at the furnace wall is then nothing other than the weakening of the generated signal, which ultimately is equivalent to attenuation. The attenuation depends on the foaming slag height, as the vibration transmission path mainly passes through the steel phase, and only to a minor extent via the gas or slag phase.

Very encouraging results

In the first two test series, the primary objective was to determine the feasibility of the sensor technology. For that reason, only one sensor was examined at furnace phase 3 at first. As mentioned at the beginning, this was also done by way of comparison with current analysis and directional sound analysis. Three different measuring methods are shown in figure 3. The plot in the upper part is the current analysis (FFT), the middle one is the directional microphone method, and the lower one represents the structure-borne sound method. A glance at the top two measuring methods reveals deviations from the actual behavior, which is defined by the evaluation of the video signals. The blue curves in each case represent the injection of oxygen and carbon, signals which are not used to produce the algorithm, but rather to determine plausibility. The operator's personal impression is plotted as the green curve. The first two methods have the disadvantage that the actual trend of the foaming slag height does

not correspond to the calculated trend in all respects, which would lead to an inversion of the control characteristic in fully automatic operation. With the structure-borne sound method, however, the trend always corresponds to the actual foaming slag trend, enabling the first attempt at a control algorithm on a neutral basis to indicate genuine behavior. Figure 4 provides verification of the structure-borne sound method. Simultaneous image inputs from the image evaluation were assigned to specific data points, the "foaming slag signal." The curve of the values obtained using the structure-borne sound method can be superimposed on the image data with very good reproducibility.

In subsequent analyses, the principle was modified so that the influence of the three phases (3 current signals) was evaluated in relation to each structure-borne sound element.

Details of analysis results

This series of analyses has led to some very informative results. Vibration analysis on the furnace panel is capable of mapping the formation of foaming slag in space and over time, and it produces better results than current or microphone analysis. The spatial distribution can be represented, and the system can be controlled for greater uniformity by means of burners/injectors arranged at different locations. Initially, the detection system can be supplied on its own because the visualization alone enables appropriate measures to be taken to make the formation of foaming slag more uniform or to optimize it. This shortens tap-to-tap times even during an early phase. Following completion of the development work, there will be no difficulty in loading the control algorithm needed for fully automatic control of foaming slag formation into existing detection systems, and to adapt the hardware or the detection software. ■

Sales release for AC foaming slag detection and control systems

Sales release for detection on its own was granted in March 2006. Phase II, i.e., the commissioning of the prototype for online detection, took place in April 2006. Currently, a line analysis is being run in which, in addition to the foaming slag data, all data required for operation of the furnace is recorded from the basic automation in order to facilitate the writing of algorithms or patterns for a hybrid furnace control system. Generation and commissioning of the control algorithm will be completed by the end of September 2006, meaning that sales release for the control system should be granted by December 2006.

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Advanced technological packages upgrade slab casters worldwide

Casting Benefits

Following the introduction of technological packages for continuous casting machines in the early 1990s, Siemens VAI has since upgraded more than 190 slab casters worldwide. The author explains how these technological packages can achieve major improvements in the productivity, product quality and operational flexibility of continuous casting operations.



IRON & STEEL >

Efficient and competitive steelmaking and, in particular, continuous casting operations require the ongoing improvement of facilities to satisfy market demands.

Technological packages from SmartMold to Connect & Cast

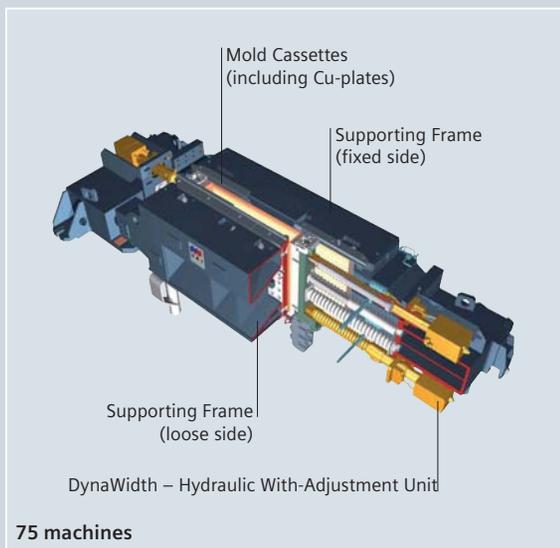
Installation of Siemens VAI technological packages at different sections of the caster can lead to significant improvement in continuous-casting operations. The SmartMold, for example, features a low-weight, yet highly rigid, cassette-type mold design with a reduced number of operational exchange parts. Both the mold and worn copper plates can be exchanged quickly, increasing the unit's overall availability. Integration with the DynaWidth hydraulic mold-width adjustment system, also from Siemens VAI, enables fast and automatic slab width changes.

The patented DynaFlex® hydraulic oscillator is a technological package comprising a foundation frame and two individually exchangeable and interchangeable oscillator units, each mounted on a separate leaf-spring-guided mold table and equipped with a hydraulic cylinder. In addition to a freely selectable stroke, frequency and curve pattern, an inverse oscillation mode reduces the depth of the oscillation marks, improving strand surface quality. DynaFlex is virtually maintenance-free and is suitable for molds of all types.

Featuring fully-remote adjustment, the SmartBender supports quick strand thickness changes in the first caster segment. This is a major operational benefit for producers who must change slab thicknesses frequently, but still require high caster productivity. Designed as a self-standing low-weight unit, the unit is equipped with automatic water and air couplings.

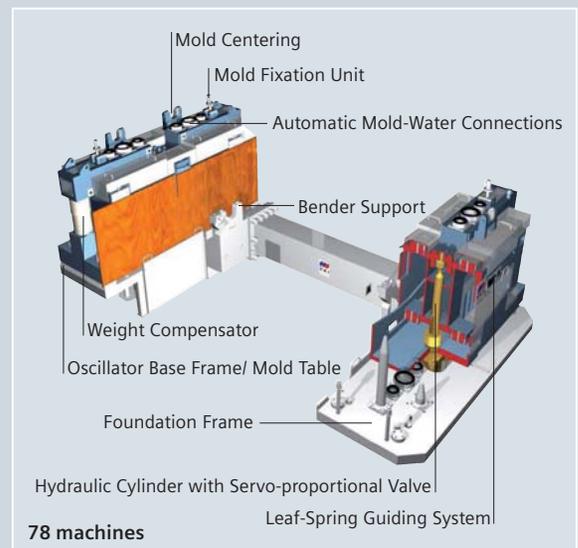
Together with the SmartBender technological package, the rigidly designed SmartSegment® enables fast slab thickness changes to be carried out through the remote and online adjustment of the roller gap of the strand guide system. When linked with the Dynacs® cooling model for calculating the final point of strand solidification and the DynaGap model for calculating the roller-gap set points, the optimum roller gap and strand taper can be adjusted even during transient casting conditions. This enables soft reduction, which improves internal strand quality, especially for pipe and plate grades. As of July 2006, more than 59 casters equipped with Smart have been sold since 1997, accounting for 90% of the total world market share.

The Siemens VAI engineering design of Connect & Cast® technological packages (DynaWidth oscillator, LevCon mold-level control, DynaWidth mold-width adjustment, secondary-cooling systems, and DynaGap) take customer requirements into consideration during detailed engineering of the mechanical, fluid and automation components and systems. Workshop testing ensures the proper functionality and reliability of the overall system. These measures contribute to the



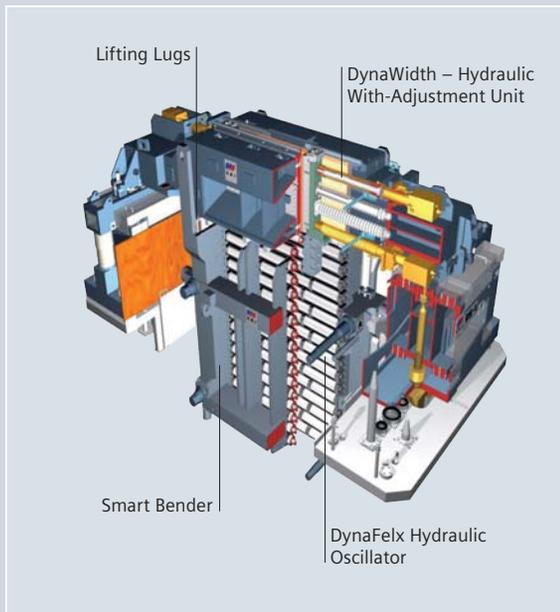
75 machines

The SmartMold high performance cassette-type mold

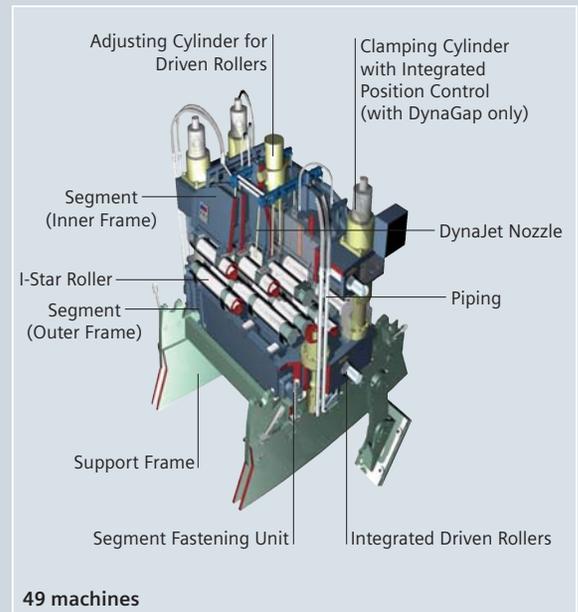


78 machines

DynaFlex hydraulic oscillator



The SmartBender for fast slab thickness changes



49 machines

Remote and online adjustment of the roller gap of the strand guide with SmartSegment

shortest possible start-up and ramp-up times, minimum production downtimes and dynamic operation of all systems right from the first heat.

Advanced solutions that pay big dividends

Return on investment is a function of improved revenues, which result after the resumption of normal casting operations upon completion of the upgrading activities. This is determined by the increased production capacity, by higher profit margins for higher quality products, or both.

An analysis of the different times required for a plant shutdown and the subsequent commissioning/ ramp-up period gives a strong indication of the potential revenue benefit that can be achieved. Even with a shorter ramp-up time of just a few days, the resulting revenue improvement can exceed one million U.S. dollars using advanced Siemens VAI casting solutions.

Installation of Connect & Cast solutions can help to shorten the total caster shutdown time significantly. In a case study with a 20-day shorter shutdown time, a surprisingly high revenue benefit was calculated at 13 million U.S. dollars! All in all, the biggest dividends are obtained in a caster upgrading project when both the caster downtime for upgrading as well as the start-up curve are kept as short as possible. Not only do the outlined solutions contribute to improved caster performance and product quality, the total investment expenditures for caster upgrading can be recovered within an extremely short time period. ■

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Advantages of the Siemens VAI MES solution

Traceability of all process data and production conditions

Consistent product quality due to integrated quality assurance

Quick response to process deviations

Intelligent resource management leading to more efficient use of equipment

Reduced downtime due to optimum planning of all maintenance measures

Flexible production planning and scheduling

SIMATIC IT MES standard software leads to fast system rollout and low Total Cost of Ownership (TCO)

The performance of a plant was previously determined to a great extent by the technological controls and regulators used, as well as by the basic process models, which together enable accurate, flexible production and guarantee reliable, fully automatic operation. But attention is being focused increasingly on the non-production-related activities such as

provide up-to-date projections of the plant and production status.

This gap is bridged by manufacturing execution systems (MES) on the operations management level. These systems gather as much plant and product data as possible, compress the large volume of data into informative key variables (KPI) such as plant performance and product quality, and make the information available as a basis for operative and managerial decisions. The plant manager receives an accurate overview of production and the condition of the plants in the steelplants, while the unproductive activities and any quality, workload and logistics problems in the downstream process are detectable at a glance.

Increased steelplant efficiency through IT standards

Bridging the Gap

Steelplants must constantly reduce production costs, but at the same time are expected to maintain high quality and production standards. A prerequisite for this, in addition to flexible and highly available production plants, is uniform information and data management between processes, plants and management. Data transparency can help optimize the entire productivity chain, including all production, logistics and ancillary processes.

raw material consumption, resources and time. These efforts involve implementing better production and logistics concepts that offer a high degree of standardization and control of the entire production process, including improved material management and product tracing in the case of complaints or quality issues. The trend is therefore moving toward networking distributed intelligence and to master platforms (the so-called manufacturing intelligence), which offer transparent representation and processing of information to allow the manager to make rapid decisions.

The gap between management and production

In many companies, achieving this intelligence is thwarted by information technology that is still characterized by information "islands" or individual solutions. Although many companies use enterprise resource planning (ERP) systems such as SAP R/3 as a management tool to organize the financial aspects of the production process, these systems' functionality is often not sufficient to clearly determine whether the products can also be delivered with the desired quality and in the required quantity at the scheduled delivery time. As a rule, these systems lack the ability to

and they manage equipment such as ladles and moulds. They provide the production managers with an overview of processing and transport times, identify resource bottlenecks and provide product-specific work instructions, enabling the production processes to be better synchronized. Automatically controlling the plant is largely ruled out by the special characteristics of the production process. An essential task of the MES in the steelplants today is therefore the provision of easy-to-use support functions that simplify the decision-making processes.

An MES must be able to project existing plant know-how so that conclusions can be drawn about faults in the setting of a product specification from a comparison of current process data with earlier process data and identical products, and corrective measures derived. Possible product quality defects can be detected by continuous analyses of the actual state of the material (comparison between specification and incoming samples).

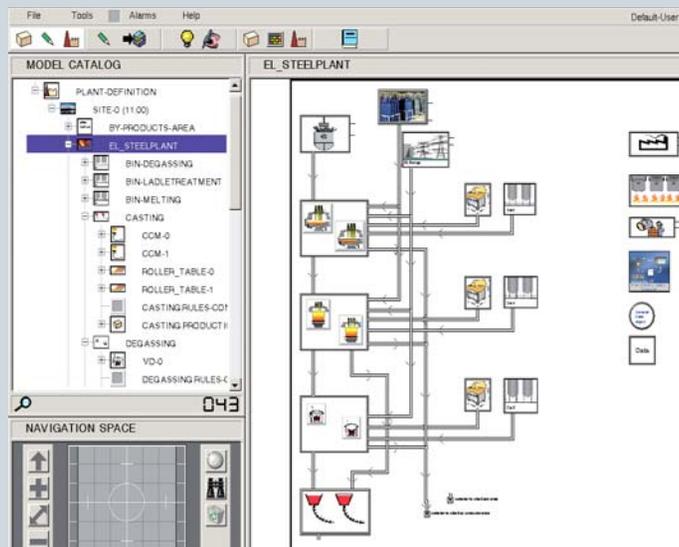
All production and process data are recorded and archived (Tracking and Tracing) and allow continuous traceability (Traceability and Genealogy). In the case of quality problems and complaints, the history of these materials and all products affected by the same prod- >>

Better planning and execution with MES

The modules of an MES are aimed at data collection, material tracing, production planning and execution, as well as setting defaults for production. They optimize the production sequence of the material pieces to be produced based on the order dates and the amounts to be produced, and supply a clear reference to a customer or production order. They take into account plant- and material-related restrictions and the current and planned capaci-



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The Siemens VAI MES solution is based on Siemens MES standard software and used to design the custom plant configuration according to ISA S96

>> uct cycle can quickly be identified. Complete product documentation can be created for a delivered product (e.g., slabs or billets) or an intermediate product (e.g., heat) on demand. The system has already acquired all of the product and production route data, and can therefore create a product report with the desired depth of detail. Data are available for all production steps involving the relevant intermediate materials and partially finished products.

Digital production in practice

With SIMATIC IT, Siemens offers a standardized MES platform that, in addition to production control, also includes material management and product tracking and tracing. The production processes are, according to the ISA S95 standard of the Instrumentation, Systems and Automation Society, described precisely, from the company management level to the individual cell, with material and data flow based on a generic production model. The Siemens VAI industry solution, designed especially for steelplants, provides all of the essential functions of an industry-specific MES on top

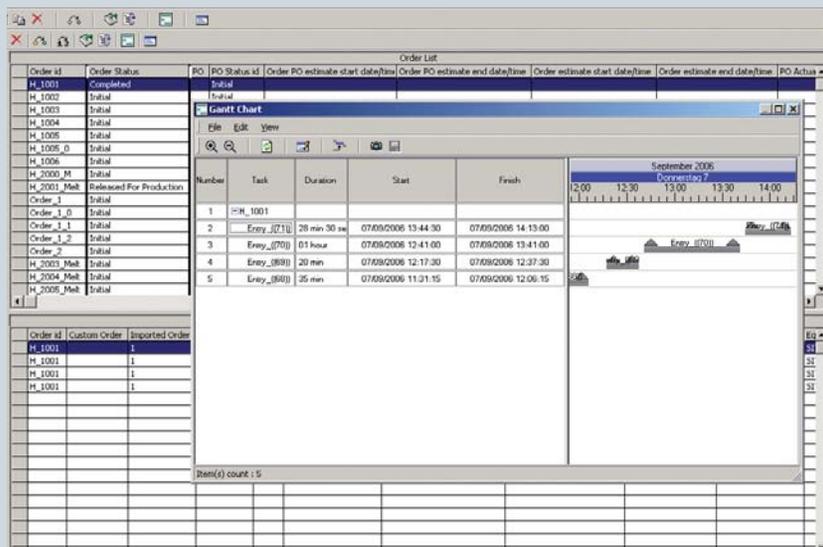
of integrated modules close to the control level. The Siemens VAI MES solution guarantees the continuous flow of all process data, both vertically up to the management level and horizontally from raw material ready for the melting units to slabs in the continuous casting machines.

The solution is therefore the ideal platform for plant-wide production planning and monitoring, and provides a basis for guaranteed quality and minimum operating costs. The system manages all of the melt-

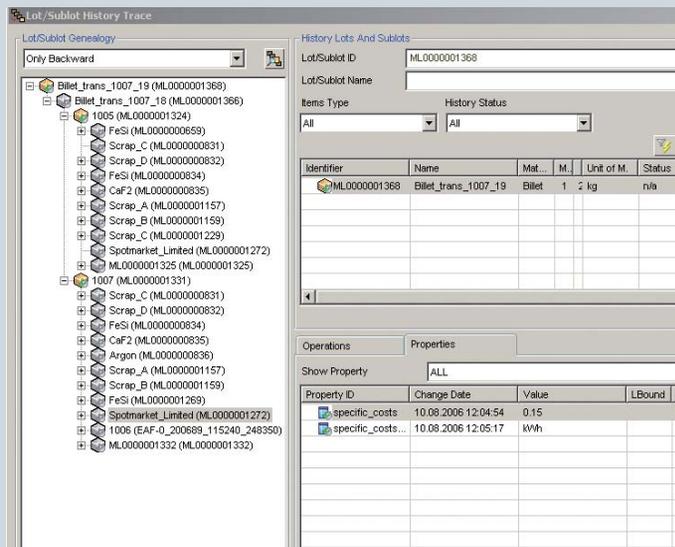
ISA S95

The international ANSI/ISA S95 standard defines terminology and models that are used in the integration of commercial systems and production control systems. The standard also defines operations that are supported by intermediate manufacturing execution systems (MES).

(ISA = Instrumentation, Systems and Automation Society)



The Siemens VAI MES solution integrates all production-related data such as order management information and production status to minimize response times in ongoing production



With the Siemens VAI MES solution, complete product documentation can be created for a delivered product or an intermediate product on demand

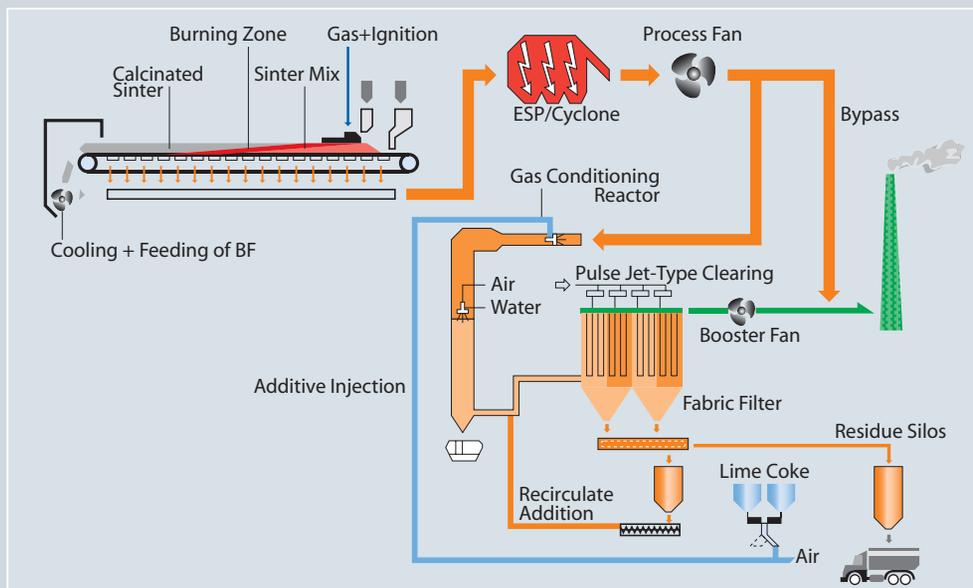
ing sequences of the steelplants, starting with the orders for slabs or billets. Deviations from expected times or events that can endanger further production can be responded to quickly. The system also involves all of the resources used and available in the production control to create a feasible production plan. In addition to production plants (starting with the melting process in the electric arc furnace (EAF) and moving through secondary metallurgy to the continuous casting machine), this also includes equipment such as ladles and auxiliary units (ladles and tundishes, etc.).

An integrated quality assurance system not only evaluates the material quality, but also prevents quality problems by taking adequate measures based on rule-based checkpoints at significant locations in the production line. This also allows immediate modification of target parameters such as reprocessing by additional work procedures. The Siemens VAI MES solution includes predefined production rules that can be easily adapted to the customer requirements.

User interfaces and reporting are designed to meet the requirements of the steel industry, and are avail-

able to users via Web technology. The data entry – for example, in connection with existing level 1 and level 2 or other external systems – provides absolutely reliable information from the production to the control as well as the management level. In addition, this vertical data integration minimizes response times to trends in ongoing production. Management therefore receives data relating to operating states, malfunctions and production from the system in real time. For completely uniform data integration, SIMATIC IT provides interfaces to ERP systems such as SAP R/3 to enable comparison with material management, controlling or production planning. The innovation of Siemens VAI is the fact that it is based 100% on SIMATIC IT Standard Software. This reduces TCO and implementation risks. ■

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Flow sheet of the MEROS process

MEROS – a new dry-type gas cleaning process for the treatment of sinter offgas

Scrubbed Clean

A fully satisfactory, environmentally compatible solution for the treatment of the offgas arising during the sintering process has not existed up until now. In response to this challenge, Siemens VAI recently developed the MEROS® process, which stands for Maximized Emission Reduction Of Sintering. In a series of successive treatment steps, the dust and harmful metallic and organic components present in the sinter offgas are removed to levels previously unattained with conventional gas-treatment techniques. The world's first MEROS plant is currently under construction at the steel works of voestalpine Stahl in Linz, Austria.

The MEROS process scrubs offgas using adsorbents such as specially prepared lignite cokes or activated carbons, and desulphurization agents such as hydrated lime or sodium bicarbonate. These substances are homogeneously injected into the sinter offgas stream at high velocities in the counter-current flow direction. This binds the heavy metals and organic compounds (dioxins, furans and VOC – volatile organic compounds) as well as the sulfur compounds. In a so-called conditioning reactor cooling and moisturizing of the sinter offgas then takes place using highly efficient dual-flow (water-compressed air) injection nozzles. Chemical reactions for binding and removing sulfur dioxide and other acidic gas components present in the offgas stream are accelerated in this way. Minor amounts of separated substances (stickings, agglomerated material) are removed at the bottom of the conditioning reactor by a conveyor system.

Dust recycling enhances cleansing efficiency

After exiting the conditioning reactor, the dust-laden offgas stream which contains primary dust, additives and reaction products then passes through a pulse-jet-type bag filter comprised of high-performance fabric materials. To avoid penetration of the fine dusts and organic compounds (e.g., oils) into the fabric material, the fabric is coated with a chemical- and temperature-resistant membrane. The dust particles which settle on the membrane surface gradually grow into a filter cake which is periodically removed by a powerful air impulse. The filter cake falls from the cloth surface into a dust-collection hopper.

In order to enhance the gas-cleaning efficiency and to significantly reduce additive costs, most of the separated dust in the bag filter is recycled to the offgas

stream after the conditioning reactor. Unreacted adsorbents once again come into contact with the offgas, thus increasing the adsorbent efficiency and reducing the costs for consumables. A portion of this dust is removed from the system and conveyed to intermediate storage silos.

The gas which is exhausted from the bag-filter system by the booster fan is carefully monitored to assure that the prescribed emission values are maintained at all times.

First industrial application

Following a series of test campaigns conducted from 2005–2006, the technical and economical advantages of the MEROS process could be verified. On the basis of these results, the integrated iron and steel producer voestalpine Stahl signed a contract with Siemens VAI in March 2006 for the installation of the world's first MEROS plant at the company works site in Linz, Austria. The new MEROS plant will be capable of treating approximately 1,000,000 m³ of sinter gas per hour, and is scheduled for start-up in August 2007. ■

Main benefits

Unsurpassed cleaning of sinter offgas

Recycling of dust from bag filter to offgas stream for maximum adsorbent efficiency

High degree of flexibility with respect to the use of additives for desulphurization

Meets future environmental demands today

Removal efficiency

Clean-gas dust content:
< 5 mg/Nm³

Heavy metals: > 95%

Dioxin/furans: Up to 98%

Acid gases (HCl/HF): > 90%

Condensable organics (VOC):
Negligible remnant

Degree of desulphurization:
• Hydrated lime: up to 80%
• Sodium bicarbonate: >90%

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New 1,700 mm hot strip mill at China's Tangshan Iron and Steel

Quality Strip in Record Time



Commissioning team after first coil

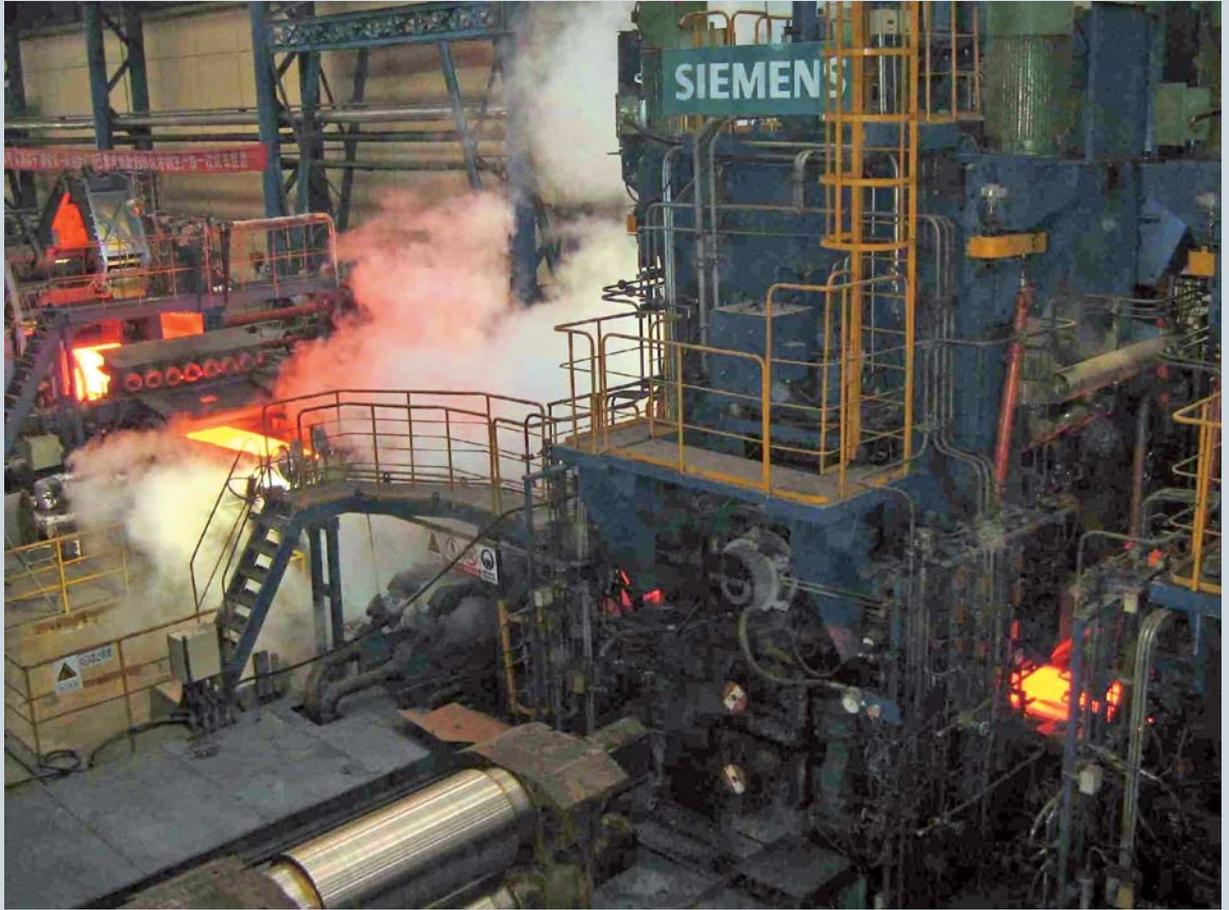
The Tangshan Iron and Steel Corporation, headquartered in the city Tangshan, Hubei Province, is among the largest iron and steel manufacturers in China with a crude steel output of 5.4 million tons in 2005. A new 1,700 mm hot strip mill, which took up operations at the end of 2005, will increase the company's steel production capacity to 2 million metric tons per year. The plant is exceptional for several reasons: The customer assumed a high degree of responsibility in the overall project organization within a very short overall project timeline, particularly concerning commissioning and production ramp-up time.

The new mill is designed for a capacity of 2 million metric tons per year with a maximum strip width of 1,550 mm. It comprises a roughing mill with edger; a coil box (featuring technology from Steltech, Canada); a finishing mill with six stands and with provision for an extension to seven stands; a laminar cooling area and two down coilers. The furnaces were designed to deliver slab thicknesses of 150 mm with widths varying from 850 mm to 1,550 mm. Final strip thickness can vary between 1.5 mm (1.2 mm with Stand F7) to 12.7 mm.

Tight project schedule

Siemens VAI provided the automation for the entire mill line, and a large portion of the electrical equipment, supplied locally by Siemens Ltd. Beijing.

For the solution, the SIROLL^{CIS} HM concept for hot strip mills was used. Among the functions for the >>



Entry side finishing mill

>> basic and process automation, the following features should be highlighted:

- Width model and related short stroke and inline width control functions (SSC, AWC) for the roughing stand with hydraulic edger
- Various operating modes for the coilbox
- Model-based finishing mill setup with the latest profile contour and flatness model, making use of the entire range of contour adjusting and work roll bending facilities in the finishing mill
- Model predictive controller for advanced strip temperature control within finishing mill for new steel grades and ferritic rolling, making use of the interstand cooling devices and the roll gap lubrication
- Cooling section process models with online determination of the strip temperature course over the cooling section
- Mill pacing for optimizing mill throughput and avoiding delays in the bottlenecks of the mill

As the engineering time was remarkably short (only 16 months between the contract signing in April 2004 and the beginning of installation work) the advantages of the Siemens SIROLL^{CIS} HM concept were very successful:

- High degree of standardization in the system architecture and functional modules

- Widely used automation hardware – Simatic-based, therefore no problems with delivery times
- Skilled engineering team with experience of comparable hot mill projects

The functional and interface coordination occurred on the basis of reliable documents so that within 4 coordination meetings, the external specifications were already finalized. Due to the high degree of prefabrication of the automation equipment, the system test was performed over a period of only 6 weeks, thereby demonstrating the communication, the HMI functionality and important functional sequences such as:

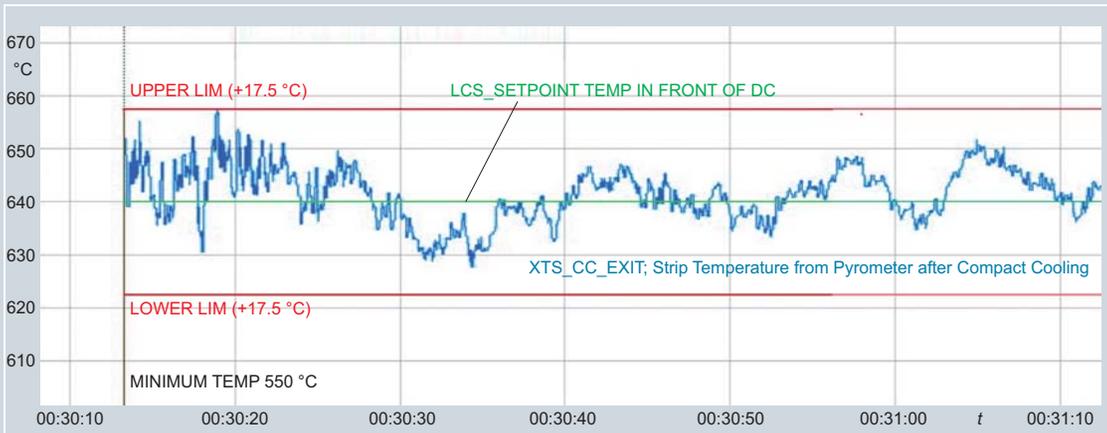
- Roughing mill rolling simulations
- Coilbox coiling and uncoiling sequences
- Stand calibration
- FM looper and loop control
- FM rolling with inactive stands
- Coiler functions
- Manual interventions
- Emergency Stop

Quality strip after just three weeks

Although the mechanical installation was delayed by six weeks, the joint commissioning teams remained on schedule for rolling the first hot coil. The next challenge to meeting the expectations of the customer for



Thickness deviation of 3.5 mm strip within 33 μm after three weeks



Absolute coiler temperature within +17.5 °C after three weeks

final acceptance after just four months of hot rolling operation.

Siemens used the engineering and system testing period in Erlangen to train and involve customer personnel in all aspects of the software, and generate confidence and familiarity in its use. This made it possible to limit the number of Siemens supervisors on-site, while also giving the customer personnel the chance to work with the plant from the first day on, and thus to achieve the ambitious targets. Indeed, final acceptance was signed after only four months, with very few open remaining issues. Production ramp-up was very quick and comprised the three factors of quantity, variety and quality. After rolling the first strip on December 21, 2005, a total of 1,468 tons of rolled product were produced in December, followed by 31,648 tons of rolled product in January and 55,552 tons in February 2006. Limitations resulted out of the fact that only one reheating furnace was in operation at that time and prevented higher production.

In the same way, the product mix was extended to a wide range of steel grades. These steel grades include carbon-structure steel, high-quality carbon-structure steel (incl. low carbon), low-alloy high-strength structure steel, automotive beam steel, and weld-bottle steel. Even more impressive is the fact that already in the

early start-up phase excellent performance figures were achieved. The charts above show the thickness performance for a 3.5 mm strip, rolled 3 weeks after the first strip. The absolute tolerance of the strip body is within 33 μm, which corresponds with a 1 sigma value of better than 11 μm. The coiling temperature performance is comparably excellent (see figure above).

Plant expansion on the way

Most importantly, the original requirements expressed by Tangshan Iron and Steel involving short start-up, fast production ramp-up, high product quality, have been fully met. This settled the establishment of a long-term relation with Siemens to safeguard the investment. The customer has already ordered the 7th stand extension and a 2nd reheating furnace. The related adaptations for the automation are in progress and the mill is expected to operate at full capacity by the beginning of 2007.

Customer requirements

- Short start-up
- Fast production ramp-up
- High product quality
- Long-term relation for future proof investment

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Picture: TKS

New roll eccentricity compensation system ensures uniform strip thickness

New Vitality in Cold Rolling

Closed-loop gauge control in cold rolling mills is often subject to roll eccentricities due to the design of the stand or influences from the rolling process. A new Roll Eccentricity Compensation (REC) system has been developed by Siemens to measure strip thickness, the rolling forces and tensile stress at the entry side of the rolling stand, and thereby reduce thickness deviations by as much as 50 %. The authors examine the REC system and discuss how it is breathing new life into cold rolling processes which depend on older equipment.

The most important variables determining cold-rolled strip quality are material properties, strip flatness and final strip dimensions. Getting strip thickness to within narrow tolerances is particularly important. On one hand, thickness variations of the final strip arise from thickness variations in the incoming strip. On the other, variations are caused by forward slip effects with an impact on the tension. Eccentric rolls, however, are frequently the cause of deviations in strip thickness that can be as much as several 10 μm .

How eccentric rolls impact strip thickness

On older cold rolling stands, both the back-up rolls and the work rolls can be affected by eccentricities. In the case of back-up rolls, the source of these disturbances is usually the shells of the Mergoil bearings adjusted asymmetrically via drive keys. Thermal asymmetry or grinding imprecision of the back-up or work rolls can also cause eccentricities. Since both the back-up and work rolls (and also the intermediate roll on a six-high stand) are usually not in pairs of rolls with exactly identical diameters, each roll creates oscillations with an eccentricity frequency.

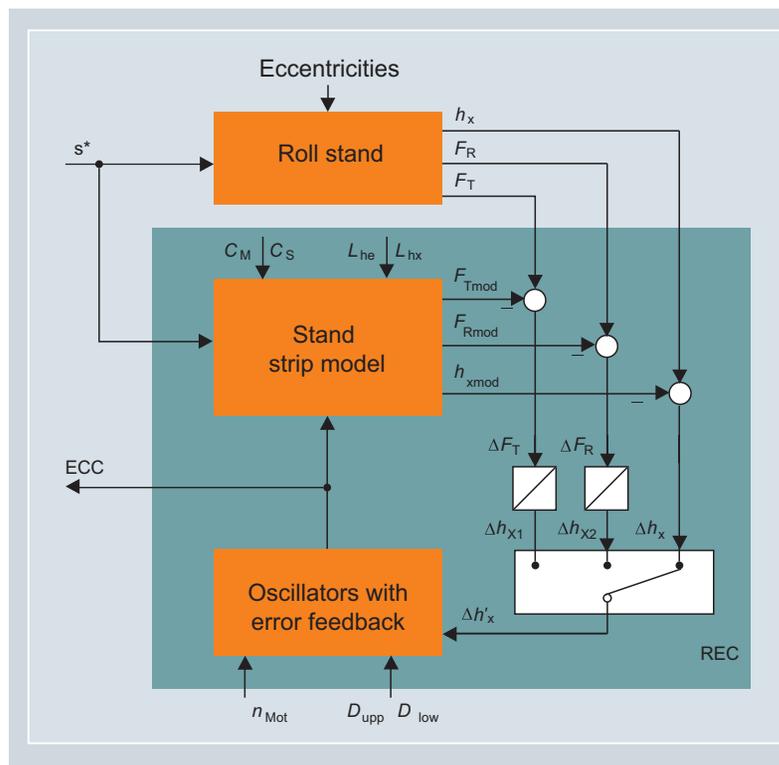
Eccentricity compensator in the closed-loop control concept

Up to now, compensation systems for which the rolling force or the strip thickness is taken as a measure of roll eccentricity have mainly been used. In contrast, the

new REC system from Siemens uses not only control variables such as measured thickness deviations, rolling speed and rolling force, but also the tensile stress measured in front of the stand. With the help of a process model, the REC system maps the behavior of the set of rolls in the mill train and generates reliable data on the eccentricity of the individual set of rolls. Additional setpoints for the position of the roll gap control are derived from this data, and these setpoints are then passed on to the hydraulic screwdown system. As a result, strip dimensions can be maintained with greater uniformity than with normal methods.

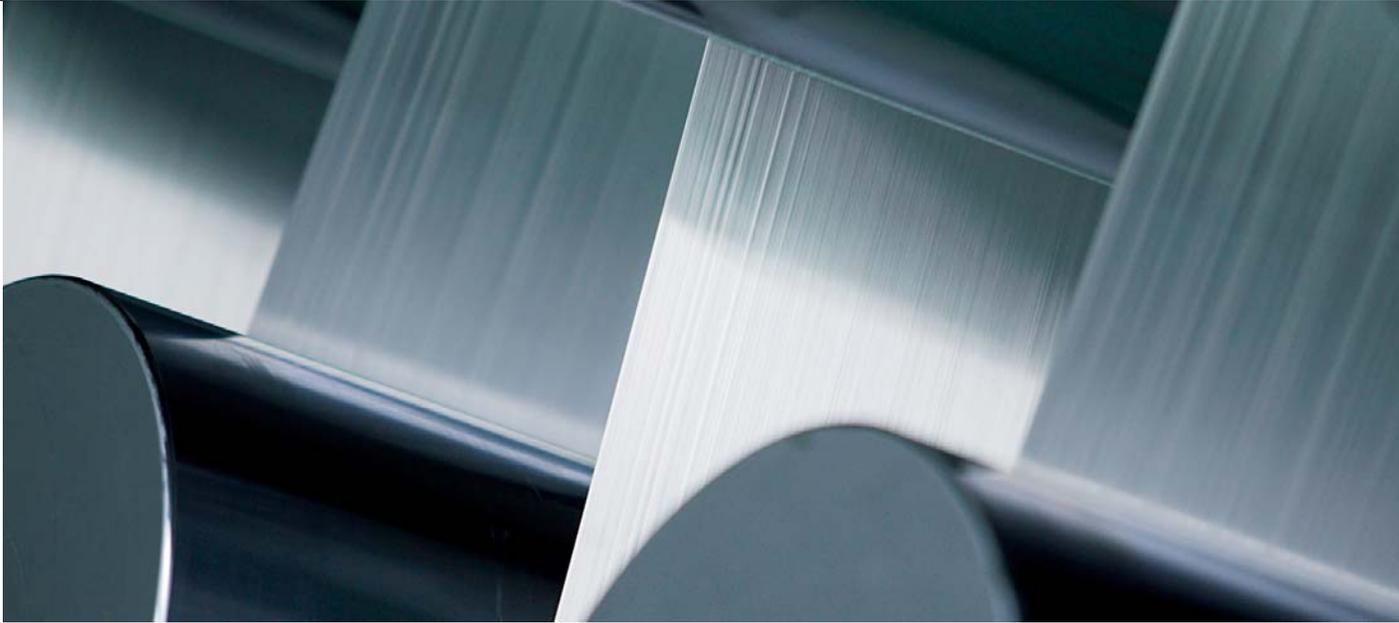
A stand is usually operated with subordinated closed-loop position control, giving rise to the problem of eccentricities being rolled into the strip. To keep the roll gap constant in this case, REC provides reference values for position correction. This applies, regardless of the selected REC mode (strip thickness, roll force, or strip tension). The tension controller ensures a constant strip tension at the stand entry by correcting the reference value of the position control for constant strip tension. However, tension controllers are subject to technical stability limits. Yet, this alone is not enough to compensate for all eccentricities.

As preparation for commissioning, the REC is tested in roll force mode with rolls operated together without strip. Because of the internal implementation structure of the compensator, it can then be commissioned off-line during rolling operation in thickness or tension mode. In this state, the compensation signal generat- >>



REC in the closed-loop control concept

F_R	roll force
F_T	entry strip tension force
h_e	entry thickness
h_x	exit thickness
n_{Mot}	motor rotational speed
s^*	position reference
s	actual position
C_M	material modulus
C_S	stand modulus
L_{he}	distance between entry thickness sensor and stand
L_{hx}	distance between stand and exit thickness sensor
ECC	REC compensation signal
D_{upp}	diameter of upper back-up roll
D_{low}	diameter of lower back-up roll
F_{Rmod}	modeled roll force
F_{Tmod}	modeled entry strip tension force
h_{xmod}	modeled exit thickness



>> ed is analyzed. Only if the test provides a satisfactory result and the full functional capability of REC has been achieved, is the compensation signal injected. This is followed by fine tuning. Since it automatically adapts to new requirements, the REC does not require any further adjustment after commissioning.

Compensation at Samara

The five-stand tandem cold mill for aluminum in Samara, Russia, was the pilot plant for the REC functionality. Siemens was there in 2004 to modernize the automation – an upgrade of the original installation in the late 70’s – with a new SIROLL^{CIS}-based solution. The first four stands were equipped with REC. REC in stand 1 operates in thickness mode, the others in ten-

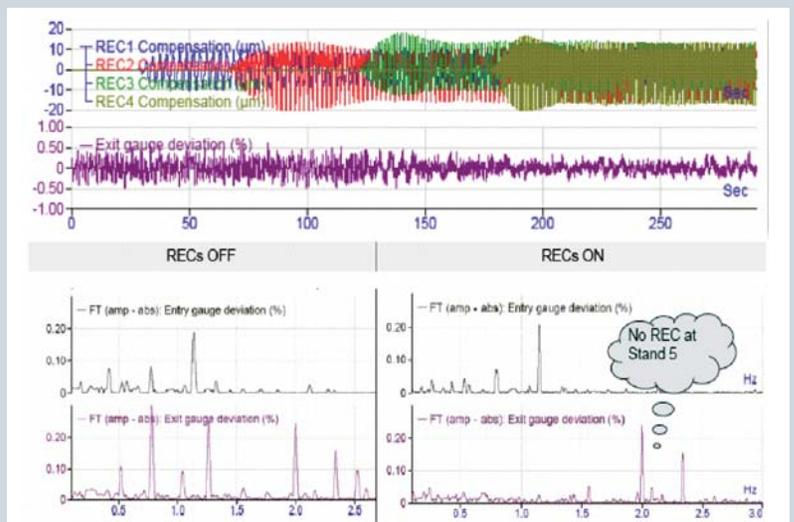
sion mode. The fifth stand operates in skin pass mode using closed-loop roll-force control. The product range includes thicknesses down to 0.15 mm with widths of up to 1,700 mm. Installation of the eccentricity compensation makes the required production of tinplate possible. The results are presented in the diagram at the bottom of this page. The upper recording over time shows how the RECs are successively connected to the stands. The various colored signals represent the generated compensator outputs ECC1 to ECC4 (ECC denotes the REC compensation signal) for correcting the reference positions.

After a settling phase, the amplitudes of the position corrections are approximately 15 μm. The lower recording over time shows the positive influence of

Gauge errors from roll eccentricities eliminated by RECs – cold tandem mill for aluminum in Samara, Russia

Strip data
Alloy: Tinplate (3xxx)
Width: 1060 mm

Thickness: 0.45 mm
Rolling speed: 10 m/s





the REC connections on the exit thickness. In particular, the RECs on stands 3 and 4 reduce the thickness fluctuations significantly. The lower part of the diagram contains frequency spectra of the entry and exit thickness of the tandem mill during two different periods. The spectra on the left arose with deactivated RECs, those on the right with activated RECs. As expected, the entry thickness spectra are similar. There is a characteristic frequency of 1.15 Hz with approximately the same amplitude. The two exit thickness spectra differ below 2 Hz due to the compensation effect of RECs 1 to 4. The eccentricity frequencies remaining above 2 Hz arise from stand 5, which is operating without REC. A comparison of the two spectra shows the very high degree of elimination by the RECs.

As can be seen from the lower recording over time, the amplitudes of the exit thickness fluctuations are about one-third less than when the RECs are inactive.

The lower part of the illustration also contains frequency spectra of the entry and exit thickness during two different time periods. As shown in the previous illustration, the spectra with inactive RECs are on the left, and those with active RECs on the right. The spectra for the entry thickness are similar this time, too. There is a characteristic frequency at 2.15 Hz with about the same amplitude. In the right-hand spectrum of the exit thickness, the eccentricity frequencies have been completely eliminated by the compensation effect of REC 1 to 4. In this case, all RECs make approximately the same contribution to improving the final thickness.

REC at China's Baosteel

The five-stand continuous tandem mill for steel at Baosteel in China was equipped with automation according to the SIROLL CM concept in 2005 as part of a thorough modernization project. Here, too, the REC was installed on stands 1 to 4. Stand 5 is operated in roll force mode. The product spectrum includes thicknesses of 0.3 to 3.5 mm and widths up to 1,890 mm.

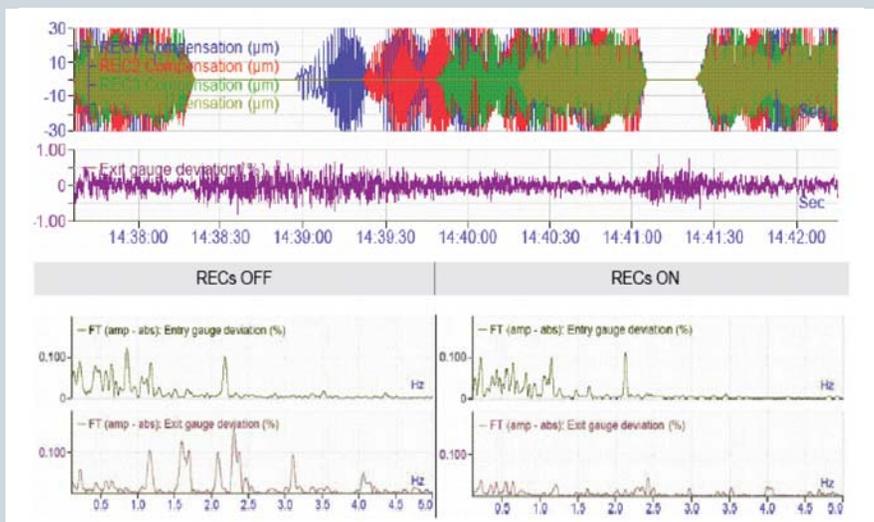
The recording over time shows how all RECs are successively connected to stands 1 to 4 and then deactivated simultaneously (see illustration below). The signals shown in different colors represent the generated compensation outputs ECC1 to ECC4 for correcting the reference positions. The amplitudes of the position corrections sometimes even reach their preset limits at 30 µm.

Proven capability to save money

With the development of its advanced roll eccentricity compensation system, Siemens has once again shown that significant quality improvements can be achieved in older plants without costly retrofitting of equipment. It is this proven capability to save customers money that has become a hallmark of Siemens development efforts in steel processing and rolling technology. The REC system is just one innovative example – one among many. ■

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The rolling results of a strip at Baosteel in recordings over time and frequency spectrums: gauge errors from roll eccentricities are eliminated by RECs at the Baosteel continuous cold tandem steel rolling mill

Strip data

Alloys: Low carbon steel
Width: 1470 mm

Thickness: 0.706 mm
Rolling speed: 10 m/s



Special mill equipment and features

Dynamic Shape Roll (DSR®) used as the upper back-up roll

Roll force cylinders employed at the bottom of the stand

Back-up roll eccentricity compensation

Wedge system for automatic pass-line adjustment

Hydraulic bending blocks for positive and negative work-roll bending

AGC (automatic gauge control) with entry and exit x-ray thickness gauge

AFC (automatic flatness control) with VAI ShapeTech (air bearing-type shapemeter roll)

Hot-spray system remotely adjustable for product width

Automatic work-roll change within five minutes

Offline coil-preparation station

Spool-transfer system and cleaning section

Automatic coil weighing and banding

View of the aluminum foil mill at CBA, Brazil

Next generation aluminum breakdown cold mill started up at CBA, Brazil

Milestone for Aluminum Rolling

In March 2006, the widest and fastest aluminum breakdown cold mill in Latin America was started up at the Brazilian aluminum producer CBA (Companhia Brasileira de Alumínio). VAI Cosim, a Spanish-based company of the Siemens Group Industrial Solutions and Services, engineered this multi-purpose facility with state-of-the-art technologies. This aluminum mill is the largest ever supplied by the Siemens VAI group of companies.



Companhia Brasileira de Alumínio

On June 4, 1955, the machines were turned on for the first time and the Companhia Brasileira de Alumínio commenced operation of a plant which was already modern and advanced for its time.

Since its start-up, CBA has been able to grow at an annual rate of 10 %, making it the biggest Brazilian producer of primary aluminum today. Also, the company is the largest integrated aluminum producer in the world, starting with the bauxite processing to the manufacturing of finished products, everything at the same plant – located at Alumínio, Spain. Today, CBA produces 400,000 tons of primary aluminum per year.

It has a self-sufficient bauxite production, extracted from its own reserves located in Poços de Caldas and Itamarati de Minas, MG. Also, CBA holds shares of Mineração Rio do Norte (bauxite) in Tombetas, PA, and in Alunorte (alumina) in Barcarena, PA.

The company owns 18 power plants currently in operation. This enables CBA to generate 60 % of the energy it consumes, even with an expansion of its production of primary aluminum to 470,000 tons per year, which will be concluded in June 2007.

In addition to this chain of production, a comprehensive distribution branch network is integrated, including 14 branches strategically deployed to supply all regions in the country.

Both roughing and finishing passes for aluminum alloys of the 1000-3000-5000-8000 series are carried out for a wide range of strip thicknesses extending from a maximum of 6 mm at the entry section down to a minimum of 0.075 mm at the exit section. Strip widths may vary between 1,000 mm and 2,100 mm. The maximum exit speed of the line is 2,100 m/min. In order not to restrict mill output, edge trimming and, if necessary, center cutting is carried out in a separate line, which is linked to the rolling mill by means of a fully automatic coil-circulation system equipped with a double-row pallet conveyor. Mill entry and exit equipment were designed to enable semi-automatic threading of thinner aluminum gauges employing air-cushioned feeding devices. The special design of the work rolls and drive spindles prevent vibrations even at highest rolling speeds.

Extraordinary operation flexibility

The mill is equipped with Siemens VAI TCSs (technological control systems) in addition to a quality-control package. Powerful flatness actuators and a sophisti-

cated control system enable the rolling of a wide range of products without the need for frequent roll changes. This gives CBA an extraordinary flexibility in their production operations. A roll-pass scheduling model linked to a coil-tracking system as well as a coil-handling system optimize overall production according to order requirements. The mill was manufactured in the European Union, and the stand was completely shop-assembled and tested in Spain prior to shipment.

Main benefits

High yield and operation flexibility for improved productivity

Automated coil transport with limited operator intervention and crane handling

Extraordinary flatness results for production of first-class quality products

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ROLLING & PROCESSING >



Technological highlights of the new hot-strip mill at
Mittal Steel Poland in Krakow

Turnkey for Productivity

The first new hot-strip mill to be built in Europe during the past ten years is now under construction at Mittal Steel Poland in Krakow. Following the start-up scheduled for early 2007, this 2.4-million-t/a facility will be capable of producing a wide range of carbon, stainless and special-steel grades in widths of up to 2,100 mm – one of the widest mills of its type in Europe. Siemens VAI will implement the project as a turnkey solution, including engineering, construction, start-up and plant commissioning.

For this major rolling mill project, Siemens VAI will engineer and supply a walking-beam reheating furnace, a reversing roughing mill with attached edger, a 6-stand/4-high finishing mill, a strip-cooling section, coiling section, all of the electrical, utility and automation systems in addition to auxiliary plants such as the roll shop and water treatment plant. Additionally, all civil works in the existing mill bay – previously a slabbing mill – will be handled by Siemens. Training for operational and maintenance personnel will also be provided.

Technological packages for rolling

As an outstanding highlight of this project, the installation of a series of advanced technological solutions and packages will assure optimized rolling operations, a high mill output and excellent product quality.

Installed after the roughing mill, the Encopanel heat-retention system conserves the heat of the transfer bars and enables a more accurate control of the strip temperature. This is achieved through the automatic and selective raising or lowering of the heat retention

panels. With this solution, for example, the strip-edge temperatures can be maintained at a higher temperature for rolling in the finishing mill, thereby avoiding edge cracking. Now applied in over 20 hot-strip mills, Encopanel is the leading heat-retention system installed worldwide.

A heavy-duty crop shear installed after the Encopanel is capable of cutting the full width and thicknesses of high-strength grades, including API steel grade X80. Highly accurate cutting is enabled by a special crop-optimization system based on the use of an infrared camera positioned behind the Encopanel, which measures the shape of the transfer bar head and tailends to calculate the necessary crop-cut length.

The finishing mill, comprising six 4-high stands, will be equipped with the Siemens VAI SmartCrown® technology package and includes an improved work-roll contour, an L-type bending and shifting block, a roll-stack deformation model and a thermal crown and wear model to ensure that highly rigid standards for strip profile and flatness control will be met.

With the use of a sophisticated profile and flatness model, the SmartCrown work-rolls are shifted to match the roll contour to the crown of the incoming strip. The result is a final strip profile and flatness satisfying the tightest dimensional tolerances. Another major advantage is the avoidance of quarter buckles through local thickness reductions in quarter buckle sensitive areas of the strip. Rolling with SmartCrown work-rolls is normally carried out in combination with work-roll bending.

The aim of the profile- and flatness-control strategy is to establish a certain roll-gap shape for each stand with the use of roll-gap actuators. The calculation of the roll-gap shape takes into consideration the material cross flow, which is high in the initial stands of the finishing mill and close to zero in the final stands. >>



Encopanel heat retention systems conserve the heat of the transfer bars and enable a more accurate control of the strip temperature



The finishing mill, comprising six 4-high stands, will be equipped with the Siemens VAI SmartCrown® technology package

>> The L-Type Bending Block solution for positive work-roll bending was developed by Siemens VAI to reduce mill-stand investment costs and maintenance downtime. The system functions on the basis of moveable L-shaped structures, which are guided inside the unit housing in the vertical direction to exert pressure on the work-roll chocks (Figure). This design solution offers the advantage of reduced bearing play, which results in a more exact adjustment capability of the work rolls.

The exact calculation of the shape of the loaded roll gap is a decisive factor for proper profile and flatness control by the process optimization system. This is made possible through the application of an advanced roll-stack deformation model, which is a full 3-D elasticity model that takes into consideration the real geometry of the roll barrel and necks, the applied roll and bending forces as well as the actual pressure distribution between work- and back-up rolls. With the same accuracy as time-consuming 3-D finite-element computations, the roll-stack deformation model can perform the required calculations within milliseconds, allowing the necessary roll-gap adjustments to be instantly executed, particularly for the incoming strip head ends.

The Thermal Crown and Wear Model, which calculates thermal crown and wear in real time and 3-D to determine the precise roll shape, provides necessary data input for the roll-stack deformation model. The Thermal Crown Model keeps track of the thermal expansion and contraction of the work rolls during rolling operations.

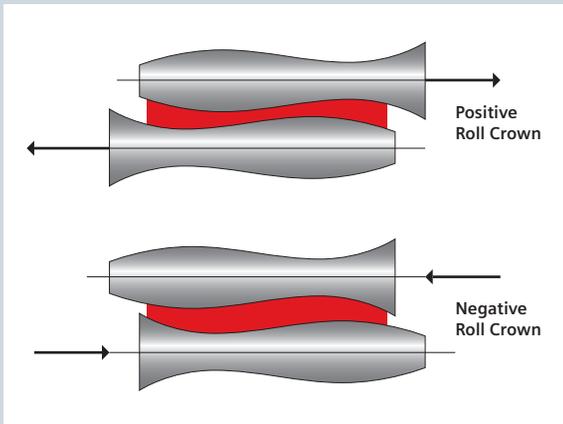
Deviations in the thickness of the hot-rolled material can be caused by thickness deviations present in the

incoming strip, as well as by thickness deviations which arise during rolling as a result of temperature variations present in the strip from, for example, skid marks caused in the reheating furnace. The objective of the feed-forward control system is to identify thickness and temperature deviations in the intermediate sections of the finishing mill, where thickness and temperature measurements are normally not possible. With the application of a Kalman estimator, such deviations can be identified and correction values applied at the downstream mill stands to achieve the narrowest thickness tolerance values at the centerline of the rolled strip.

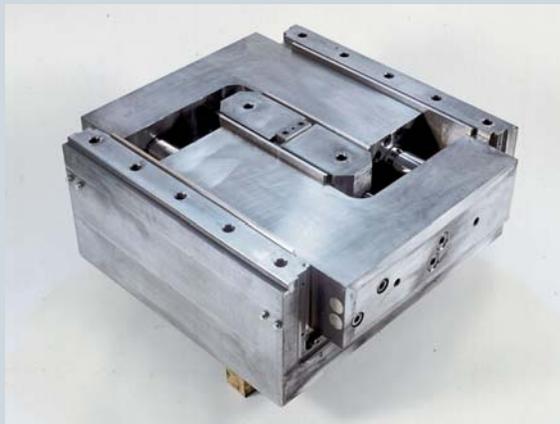
Cooling and coiling sections

In the cooling section of the hot-strip mill, QuickSwitch cooling headers will be installed to reduce the time required for on/off water-flow operations to less than one second. In conventional mills, normally several seconds are required for this procedure, making an accurate control of the coiling temperature of the strip difficult. With the QuickSwitch solution, the water flow is immediately laminar and, in combination with a hot-strip cooling model, a precise cooling strategy can be set-up tailored to the steel grades being rolled and their respective rolling parameters.

In the coiling section, two so-called PowerCoilers will be installed at the end of the mill to provide improved and more compact coiling of high strength steel grades – especially for thicker gauges – with significantly reduced strip slippage and scratching. A key focus of this development was to employ the pinch rolls and the first



With the use of a sophisticated model, the SmartCrown® work rolls are shifted to match the roll contour to the crown of the incoming strip so that strip profile and flatness will satisfy the tightest dimensional tolerances



The L-Type Bending Block solution for positive work-roll bending helps reduce mill-stand investment costs and maintenance downtime

Product data

Capacity	2.4 million t/a
Slab thickness	220 and 250 mm
Strip thickness	1.2–25.4 mm
Strip width	750–2,100 mm
Max. coil weight	Max. 35 t
Specific coil weight	Max. 21.6 kg/mm
Steel grades	Structural steel, API pipe grades (X70, X80), automotive grades (DP, TRIP), HSLA grades, silicon steels (GO, GNO), austenitic and ferritic steel*

*API – American Petroleum Institute; DP – dual phase; TRIP – transformation induced plasticity; HSLA – high strength, low alloy; GO – grain oriented; GNO – grain non-oriented

wrapper-roll unit to prebend the incoming strip so that the threading efficiency for the initial coil windings could be significantly improved with a simultaneous reduction of friction between the strip and coiler aprons. Advanced control systems will be installed to enable dynamic step control and force control of the wrapper rolls, depending on the strip dimensions, non-linear hydraulic gap adjustments, hydraulic pinch-roll control, hydraulic side-guide control, strip-tension control in addition to a number of special functions.

Automation and electrical systems

Process optimization systems will be installed which include dynamic models for computing product and

mill behavior for the pass schedule calculation. In addition to the technological packages described above, these will also cover quality-data evaluation, reporting and operator-interface functions. The technological control systems will assure fulfillment of the tightest material tolerances, including automatic width control, automatic gap control for the roughing mill and finishing mill, main drive speed set-point calculation, looper height and tension control, automatic profile and flatness control, downcoiler side guide, pinch roll and wrapper-roll control. Finally, the basic automation system will include sequence and movement control for slab transportation, the roughing mill, Encopanel control, crop optimization system, crop shear control, automatic work-roll change for the finishing mill, a gauging system for exact dimensional measurements of the material, downcoiler control, alarm and event handling, as well as provide a powerful HMI for the operator.

The current hot-strip mill project underway at Mittal Steel Poland fully illustrates the turnkey supply capability of Siemens VAI, showing the full range of design solutions, technologies, systems and services that can be offered from a single group of companies. It also represents an excellent example of the continuation of a life-cycle partnership between a steel producer and supplier, already extending over 35 years. ■

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Solutions for reaching 85 % plasticity ratio in cut-to-length applications

The New Generation

In 2001, Siemens VAI developed the first two units of a new generation of shape-correction heavy-duty multi-roller levelers for cut-to-length applications in strip processing lines. These were first installed at Ugine Iberica (Arcelor), Spain where the target was to achieve an 85 % plasticity ratio for reduced internal residual stresses in the cut sheets and, consequently, assured flatness during subsequent processing steps.

The power requirements for leveling are proportional to the plasticity ratio according to the following relationship: $N \{P^2/(1 - P)\}$, where N is the required power and P the plasticity ratio. This clearly underscores the importance of the plasticity ratio in the leveler power calculation and the need for

large-sized levelers to be able to plastically deform the strip to reach these values.

When comparing the results of the power calculation, 4 times more power is required to increase the plastic deformation ratio from a standard 65 % to 85 % (from 1.2 to 4.8). In addition to this, the required lev-

eler power is proportional to the square of the yield strength of the strip.

With consideration to these two critical requirements, the development of a new generation of multi-roller heavy-duty levelers became necessary to enable the combination high plastic deformation of high-strength steels. Efforts focused on using the smallest possible work-roll size which still had the necessary robustness to withstand the very high leveling forces necessary for attaining the targeted 85 % plastic deformation ratio in the cut sheets.

Special emphasis on design features

The new machine was designed according to the following criteria: maximum force to be provided by the upper beam, maximum torque to be transmitted by the cinematic chain, maximum load to be applied on the most heavily loaded work roll, efficient generation of the required power.

Special emphasis was also placed on the selection of the proper size of the backup rolls for an operational life of approximately 30,000 hours when working with high-strength steels. Deformability and structural analysis of the housings and upper beam of the machines was done to ensure the necessary stiffness to absorb the leveling forces. Correct dimensioning and design of the gearbox, distribution box and the spindles was also important in order to be able to transmit the very high leveling torques required for achieving 85 % plasticity.

Other critical issues were the flatness of the bed of work rolls across the plain of the unit in both the upper and bottom frames, as well as the linearity of each roll. To make sure that these values met the contractual specifications, specific tri-dimensional laser measurements were carried out in the machines and in the presence of the customer during assembly at the Siemens VAI workshop in Madrid, Spain. The new levelers were developed in the standard configuration, as well as with an automatic cassette-roll change using change carriages to allow a roll change in less than seven minutes.

Industrial applications

After the first two prototype units went into successful operation at Ugine Iberica, a third unit was then ordered by Ugine France Service in France, in substitution of a competitor's leveler. These first steps were followed by the sale of another ten units to different companies, mainly for automotive applications.

Additionally, the upper side of the thickness range was also tackled and a unit recently entered into operation at Siderar, Argentina for leveling heavy gauge strip up to 12.7 mm and tensile strength up to 750 Mpa with very successful results. During acceptance of the line, tests were made about the deformation (up-bend-



ing and torsion) of longitudinally slit strands out of the cut sheets, showing deformations within very restrictive contractual parameters. Another order was also booked for the company Utva Silosi in Serbia for a 15/125 leveler, again for thick and wide strip.

The aluminum business has also been introduced to this concept. By late 2004, sample aluminum coils from a Norwegian producer were successfully tested at the Ugine Iberica cut-to-length line, which was followed by an order placed with Siemens VAI from Hydro Aluminum, Karmøy/Norway for the supply of a complete cut-to-length line equipped, among many other specific features, with this new generation of levelers. The line is currently in the commissioning stage. It is important to mention at this point that aluminum can be particularly difficult to level because of its low modulus of elasticity. This means that the work-roll diameter necessary to produce 85 % plasticity is approximately 1/3 of the diameter that would be needed for steel. Furthermore, and against a common thinking, the power requirements are greater. The combined factors of the reduced roll diameter and the increased power requirement make the design of the drive shafts and the work-roll drive extensions of an aluminum leveler much more difficult than for a steel leveler of the same strip parameters. ■

Main benefits

Achievement of 85 % plasticity ratio, also for high-strength steels and aluminum

Reduced residual internal stresses on the cut sheets leading to maintainability of the flatness of the sheets, even after being slit or further processed

Long leveler service life

Considerably improved strip flatness

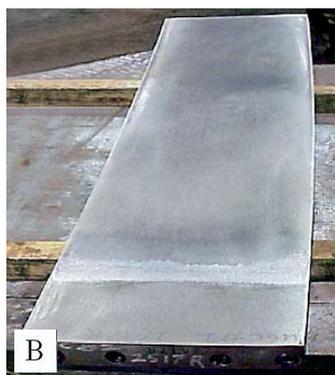
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Variable hardness hiper coat plating

Longer Life for Molds

The use of copper-coated products is a well known solution for increasing the mold lifetime and product quality in continuous-casting machines while reducing maintenance expenses. Sumitec, a division of VOEST-ALPINE Services & Technologies, LLC (VAST), specializes in the application of hardness coatings designed to meet these objectives.



Comparison of mold platings

Comparison of standard nickel (A) and variable hardness hiper coat (B) mold platings taken from the same caster; standard nickel plating (A): service life of 375 heats, full-face hardness range of 220 Hv, VHHC plating (B): 1049 heats, tapered hardness of 200 Hv top to 650 Hv bottom

At one North American steel producer, caster molds were scheduled for reconditioning when the mold narrow-face wear approached 0.050" (1.25 mm), which was reached after an average of 320 heats per casting campaign. During mold reconditioning, only narrow-face replacement was often required, as the mold broad-face wear was normally acceptable for an additional campaign.

In 2004, Sumitec submitted a set of narrow-face copper units, plated with Variable Hardness Hiper Coat (VHHC), to the steel producer for trials. When compared to nickel, which has a constant hardness of 220 Vickers (Hv), VHHC features a soft meniscus region of 200–220 Hv and a transitional hardness of up to 650–750 Hv. During casting operations, this product provides excellent ductility at high plate temperatures with exceptional wear-resistance properties in the lower copper area, where it is needed most. The benefits were immediate and spectacular, with the first trial set achieving 1,049 heats.

The early success has continued with a total of six supplied sets achieving an average of 720 heats per casting campaign. This figure includes several molds

Main benefits

Application of VHHC in a wide range of profiles and thicknesses

Substantially increased hardness over conventional nickel

Considerable increase of caster-mold narrow-face performance

Reduction of maintenance costs due to extended mold life

that were pulled from service prematurely due to scheduled maintenance outages and water-jacket modifications. This represents a 125% increase in the narrow-face performance. Through the application of the VHHC solution, the service life of the mold narrow-face has been increased to equal that of the mold-broad face. ■

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Improved overlay welding of slab-caster rolls

Reduced Mill-Roll Wear

Metal Refinishing and Improvements (MRI), a division of VOEST-ALPINE Services & Technologies, LLC (VAST), specializes in the reconditioning and manufacturing of rolls and components for hot-strip mills, processing lines and aluminum mills. Related services, notes the author, range from providing new rolls with engineered weld overlays to complete roll-reconditioning programs for all applications.

Hot-mill rolls are exposed to water, high temperature and extreme forces, which all affect roll wear and service life. The application of overlay welding, either for new or worn rolls, can greatly increase the life of these components. MRI has engineered innovative solutions with respect to the overlay materials, welding procedures and process controls that have led to major proven reductions in roll thermal fatigue, wear, pick-up, erosion and/or corrosion. The company places special emphasis on proper pre-treatment, material composition, thickness and post-treatment for the specific application to ensure the longest possible roll service life.

Industrial application and results

In 1998, MRI began implementing a roll-improvement program at the Canadian steel works of Dofasco. Descaling spool rolls, various table rolls, 14.5" descal-

Main benefits

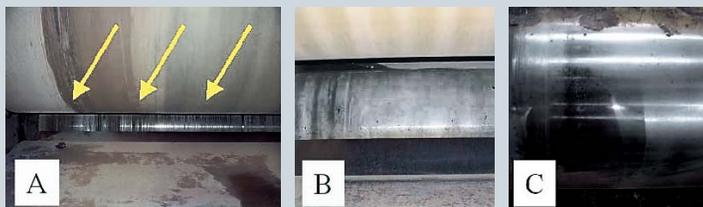
- Significantly increased roll service life
- Reduced maintenance and roll-replacement costs
- Reduced operational downtime

ing rolls, 14.5" pinch rolls, looper rolls, edge-heater rolls and 18.75"-diameter damming pinch rolls were treated with weld overlays having different properties and hardness levels. Compared to the previously used overlay or base roll material, the MRI-treated rolls demonstrated up to a threefold increase in the roll service life and the number of tons of steel produced without roll replacement. Simultaneously, roll savings of up to 45 % have been achieved through reconditioning efforts alone when compared to the costs for completely new rolls. At Dofasco, no MRI-reconditioned table roll with MRI-applied overlay welding has ever been removed from service due to roll-body corrosion, erosion, or bead-interbead issues. ■

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Comparison of roll wear

Picture "A" shows a non-MRI weld-overlayed 16"-diameter roll with significant bead-interface erosion after 175,000 tons of service life. Pictures "B" and "C" show an MRI weld-overlayed 16"-diameter roll with no visible defects, deterioration or corrosion after 275,000 tons of service. This roll was measured and re-installed



Standardized solutions strengthen competitiveness in mining

Partner to the Industry

With its wide range of integrated solutions for the mining industry, Siemens strengthens the competitiveness of mining enterprises. The solutions address every production step – from material excavation and transport to processing – as well as 24-hour service.

With Siemens solutions, mining companies will be able to react more quickly to changing market and production conditions in the future. “We create transparency with the aim of optimizing the complete production process,” explains

Dr. Markus Vöge of the Siemens Industrial Solutions and Services (I&S) division, who is responsible for Siemens global mining business. “We have an extensive portfolio of products and systems based on electrotechnical standards that we have developed for this industry.” After the automation of individual production steps, the overall consideration of all processes and techniques now offers the possibility of optimizing production based on business objectives.

Comprehensive solutions

Following the successful introduction of industry-specific product families two years ago, Siemens has further expanded its range of industrial and infrastructure systems for mining. The new MES solution SIMINE^{CIS} Prolog (see pages 60–61), for example, closes the gap between the management level and production with a consistent flow of information. With a combination of process solutions, the modernization of equipment and local services, Siemens offers security for a plant’s entire life cycle. The comprehensive, high-level consideration of production enables productivity, quality and availability to be increased, while energy requirements, costs and environmental pollution are reduced. This has been achieved, for example, at pelletizing plants. New technology increases productivity through an innovative plant design, reduces environmental pollution and considerably lowers operating costs. The improved roasting process control



MINING >



Siemens Mining Technologies supplied five ring motor systems for SAG and Ball mills in Chile for the El Teniente Division. Siemens managed the entire project, including planning, start-up and service

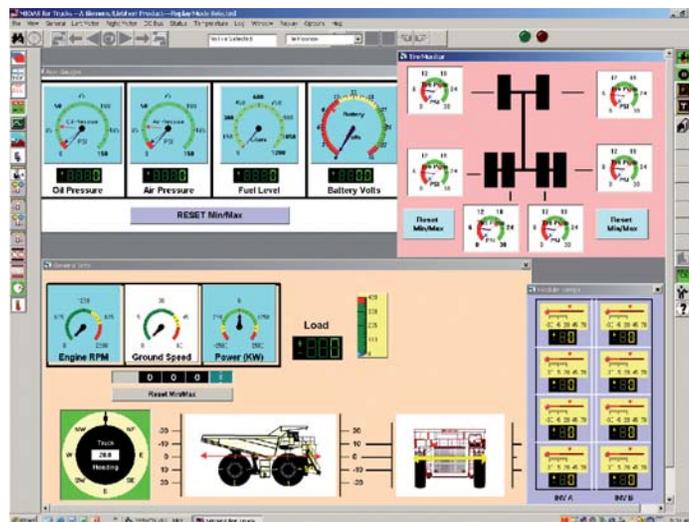


and the recirculation of process gases reduce fuel consumption and dust production. Together with optimized control of the thermal processes, the new process technology improves the overall cost-effectiveness of pelleting systems.

Increased productivity

Siemens also offers solutions for improving the cost-effectiveness of excavators. A new standard in drives was set with the introduction of the world's first gearless walking dragline. The gearless Simine Drag system replaces DC motors and mechanical gears. This minimizes maintenance and repair costs and increases productivity by up to 20%, because the extended speed range of the gearless drive allows faster loading and unloading of the excavator shovel. Siemens is already offering gearless drive systems for various areas of application in opencast mining – for example, for mills in ore processing plants and bucket chain excavators.

The standardization of maintenance systems for the remote monitoring of all components in mobile opencast mining machinery enables the integration of the Siras and Midas data input and diagnostic tools. Siras (Siemens Remote Access System) is a data input tool that makes diagnostic information available also at remote locations in real time by means of a wireless Internet link. The tool offers access to machine drive and control systems. Regular monitoring and the im-



Midas (Monitoring Interaction Diagnostic Analysis Service) for SIMINE^{GIS} TR (Trucks) collects data during ongoing operation that enable production analyses and system optimization

mediate elimination of faults by specialists ensure the highest possible availability and much lower service costs. Midas (Monitoring Interaction Diagnostic Analysis Service) collects data during ongoing operation, with which production analyses and optimization of systems can be performed. This tool gives service engineers continuous access to process, electrical and mechanical key performance indicators of all system components, enabling the creation of a preemptive maintenance profile. The analysis of the machine's performance and productivity is performed with the aid of a plant information system.

24-hour service

Siemens integrated solutions are supported by a sophisticated service plan that facilitates the trouble-free operation of plants. Siemens service technicians are on call 24 hours a day. Plant modernization is a key component of the company's extensive service offerings. The latest project in Chile, for example, involves upgrading a mill and belt drives in the copper mine of Minera Los Pelambres Ltda. The drives are being equipped with additional or new motor parts as well as transformers, converters and switchgear. The aim is to increase the grinding and transport capacities, and thus the production of copper concentrate. ■



SIMINE^{GIS} TR AC drives for trucks combines high torque, high power and ease of operation in an AC drive system – for increased payloads, shorter cycle times and higher system reliability

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MES tool integrates production planning with company goals in mining

All Processes under Control

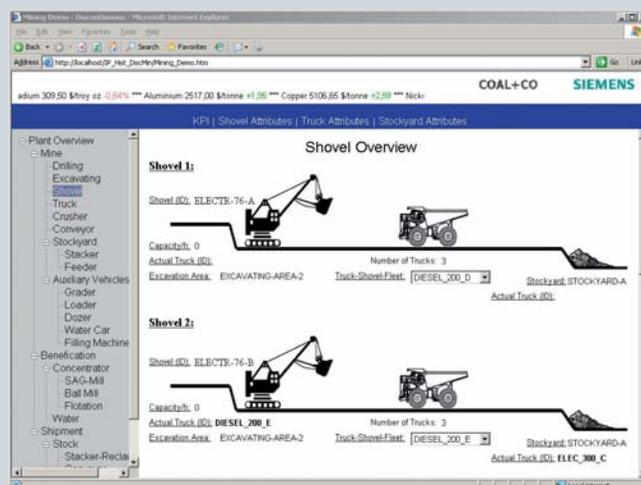
Today, mining enterprises have access to a multitude of tools for planning, controlling and monitoring production. But the complex IT landscape still suffers from the misalignment of production planning systems with strategic business objectives. Siemens closes this gap with the SIMINE^{CIS} Prolog manufacturing execution system (MES) solution. Mine owners can use this system to monitor all of the production processes – everything from excavation to grinding and secondary processes such as water treatment or storage – and optimize the processes based on business objectives.

Digging more material in a shorter time, optimizing transport capacity, preventing operating equipment from lying idle, and avoiding excessive wear – cost-effectiveness in mining has many facets. In order to survive in today's competitive marketplace, all of the possibilities to enable economical and effective production must be exploited. Transparency is an important prerequisite for optimum processes in large plants in the mining industry. It is a question of controlling materials and resources in a way that no bottlenecks, faults, or delays, which lower productivity, occur anywhere in the process. This is where MES solutions come in. MES solutions enable flexible production planning by providing transparent representation of production processes, thus increasing cost-effectiveness.

From individual software to standardized solution

With SIMINE^{CIS} Prolog, Siemens provides an MES solution that enables effective exploitation of the entire production process in mining. The modular structure offers unlimited adaptability to different processes and requirements in the plant. This flexibility allows existing plants to be integrated and adapted easily to meet special requirements. The mine's individual MES environment is integrated smoothly with all production levels such as automation, logistics and energy supply, as well as linking to the ERP (enterprise resource planning) system. "SIMINE^{CIS} Prolog is the link between the ERP level, such as SAP, and the automation level, for example, SIMATIC PCS 7," explains Karl-Heinz

Gerlach, Siemens product manager. "It represents the previously missing link – so Siemens can now offer the customer an integrated solution. We have taken the step from order-related individual software to a flexible standardized system with customized features."



The HMI interface of SIMINE^{CIS} offers a simple and intuitive layout and is easy to use



One component of SIMINE^{CIS} is the product tracking and tracing function, which monitors the raw material from excavation through transport and further processing right up to the shipment of product

Prolog components

- Production order management
- Product tracking and tracing
- Quality management
- Maintenance management
- Overall equipment effectiveness (OEE)
- Process information management

Faster decisions

The benefits of the SIMINE^{CIS} Prolog environment are not limited to the exceptional production-planning capabilities. The universal representation of all processes enables management to make quick decisions and to plan preemptively, because the MES system synchronizes, coordinates, analyzes and effectively optimizes all of the work processes. The integrated system components provide special functions for these processes.

One component, for example, is the product tracking and tracing function, which monitors the raw material from excavation through transport and further processing right up to the finished product. Production order management integrates the planning and scheduling functions. Both interactively optimize the excavation and transport of raw materials to maximize the effectiveness of operations. All relevant ERP data are further distributed to the operating units. The maintenance management function ensures that appropriately scheduled tasks and preventive maintenance are carried out in a timely and cost-effective manner.

All components, including products from third-party providers, can be integrated directly into the system, which is based on SIMATIC IT. The SIMATIC IT production modeller includes the entire production logic and data management, as well as additional libraries containing a number of specific processes. Industry- or customer-specific functionalities can be added, allowing the mining company to integrate its own individual experiences. The web-based user interface provides maximum transparency and a dynamic overview of the whole process chain in the mine. ■

■

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Award Winner

At the annual ABM (Associação Brasileira de Metalurgia e Materiais) conference, several awards in a variety of different categories of technical achievement were presented to the associate authors who had made main technical contributions at events supported by ABM in 2005.

The ABM Siemens Metals Award is sponsored by Siemens and was presented to Gilberto Parreira and Rodrigo Junqueira, process engineers from Belgo Arcelor, for their technical contribution entitled "Hearth Wear Monitoring System of blast furnace 'A' at Belgo." Their paper describes a computer system implementation to evaluate heat flows and hearth wear at Belgo's blast furnace "A" of Monlevade works. The main purpose is to provide a tool to evaluate furnace process changes aimed at hearth refractory preservation and equipment life increase.

As part of the award, Gilberto Parreira was also invited to visit the Siemens headquarters at Erlangen, Germany. ■



Iron & Steelmaking Conference



Under the motto "Impulse Next Generation Metals," Siemens VAI successfully held its

first combined iron and steelmaking conference in the Design Center of Linz, Austria from October 9–10, 2006. Siemens VAI presented the latest developments and state-of-the-art solutions for improving the plant performance. More than 60 lectures were held by steel producers and Siemens VAI technologists which focused on topics of advanced iron and steel production, innovative developments, modernization, automation, environmental solutions, training, service aspects and other highlights. The conference sessions were complimented by exhibitions, workshops, discussions and plant visits. ■

Participation in Balikpapan Expo

The Siemens product and solutions portfolio was presented to customers and visitors at the Balikpapan Expo 2006 from June 8 to 10. The event was held in a new building of the Bhumi Phala Perkasa New Workshop, Balikpapan City, East Kalimantan, Indonesia. The expo is an international exhibition of equipment and services for oil & gas, mining, power, transportation and related industries in one of the fastest growing "gateways" to Indonesia's mining and oil & gas regions, and was opened by the mayor of Balikpapan City, Mr. Imdaad Hamid SE. Siemens also sees the event as an entry to potential markets, especially in mining. Among the customers who attended the expo was Kaltim Prima Coal (KPC), a company that had contracted Siemens to replace a SCADA system at a coal preparation plant, and upgrade the PLC for a coal terminal stacker. Moreover, KPC has 39 trucks in operation that are equipped with Siemens drive technology. ■

More information

You can find further information and more press releases in our online portal at

www.siemens-vai.com

Events: Upcoming Conferences and Fairs

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| <p>OCT. 15 – 19 Materials Science & Technology 2006 (AIST), Cincinnati; www.aist.org</p> <hr/> <p>✓ OCT. 16 – 17 IFM 2006, voestalpine Stahl Linz; www.mechatronik-cluster.at</p> <hr/> <p>OCT. 16 – 18 Philadelphia, Met Coke World Summit 2006 (Intertech); www.intertechusa.com/coke.html</p> <hr/> <p>OCT. 17 – 18 Berlin: 2. Deutscher Maschinenbau Gipfel (VDMA); www.maschinenbau-gipfel.de</p> <hr/> <p>✓ OCT. 17 – 20 Curitiba: 43rd Rolling Seminar (ABM); www.abmbrasil.com.br</p> <hr/> <p>Stary Oskol: 9. Steelmaking Congress (OEMK); www.oemk.ru</p> <hr/> <p>OCT. 19 – 21 Kiev: The Metal Forum of Ukraine 2006 (DZI, MPA); www.metall-forum.org</p> <hr/> <p>OCT. 23 – 24 Columbus, US: Stainless Steel Processing (AIST); www.aist.org</p> <hr/> <p>OCT. 23 – 25 Qingdao, China, 6th China Int. Steel & Raw Materials Conf. (Cisa); www.ironoreconference.com</p> <hr/> <p>OCT. 23 – 26 Moscow, The Russian CFO Summit (Adam Smith); www.cfosummit-russia.com</p> <hr/> <p>✓ OCT. 24 – 28 Hannover: Euroblech 2006 (Mack Brooks); www.mackbrooks.co.uk</p> <hr/> <p>✓ OCT. 29 – 31 Santiago, Chile, ILAFA-47 (Ilafa); www.ilafa.org</p> <hr/> <p>NOV. 5 – 7 Prague, 22nd Int. Ferro Alloys Conference (MB); www.metalbulletin.com/events</p> <hr/> <p>✓ NOV. 7 – 9 San Nicolas, Argentina, 16th Rolling Conference and 3rd Conference on Uses of Steel (IAS); www.siderurgia.org.ar/conference/Call_for_papers.htm</p> <hr/> <p>NOV. 8 – 10 Brussels, 5th Nickel, Stainless & Special Steel Forum (MB); www.metalbulletin.com/events</p> <hr/> <p>✓ NOV. 9 – 10 Düsseldorf: Stahl 2006 (VDEh); www.vdeh.de</p> <hr/> <p>NOV. 13 – 16 Jamshedpur: 44th National Metallurgists' Day and 60th Annual Technical Meeting (The Indian Institute of Metals); www.iim-india.net</p> <hr/> <p>✓ NOV. 14 – 15 Cairo, Middle East Steel Forum (STI); www.steeltimesint.com</p> <hr/> <p>NOV. 14 – 16 Houston: Stainless Steel World Solutions USA 2006 (SSW); www.stainless-steel-world.net/ssw2006main/index.asp</p> <hr/> <p>NOV. 14 – 17 Moscow, The All-Russia Exhibition Center: 12th Metal Expo 2006; www.metal-expo.com</p> <hr/> <p>NOV. 15 – 16 Birmingham, US: Continuous Casting – A Practical Training Seminar (AIST); www.aist.org</p> <hr/> <p>NOV. 19 – 22 Osaka, Osaka University Convention Center: Galvatech '07 – 7th Int. Conference on Zinc & Zinc Alloy Coated Steel Sheet (Iron & Steel Inst. Of Japan); www.ics-inc.co.jp/galvatech07</p> | <p>✓ NOV. 22 – 24 Milano: 31th Convengo Nazionale (AIM); www.aimnet.it</p> <hr/> <p>✓ NOV. 22 – 25 Kolkata, India: 8th International Mining & Machinery Exhibition (IMME)</p> <hr/> <p>NOV. 26 – 30 Osaka: The 4th Int. Congress on the Science & Technology of Ironmaking (AIST); www.isji.or.jp/ICSTI2006-08-11</p> <hr/> <p>✓ DEC. 3 – 5 Amsterdam: 4th Steel Success Strategies Europe Conference (MB); www.metalbulletin.com/events/ssse</p> <hr/> <p>✓ DEC. 10 – 12 Dubai, 10th Middle East Iron & Steel Conference (MB); www.metalbulletin.com/events</p> <hr/> <p>✓ DEC. 14 – 15 Paris: ATS Congress (ATS)</p> |
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✓ with Siemens VAI/Siemens participation

Start-ups

- | | |
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| <p>BLUESCOPE, Australia
Project: Continuous Pickling Line</p> <p>CST, Brazil
Project: Blast Furnace No. 3</p> <p>VILLARES METALS, Brazil
Project: Bar & Wire Rod Mill</p> <p>SOLLAC Marcyck, France
Project: Linking of Pickling Line and Cold-Rolling Tandem Mill</p> <p>DILLINGER HÜTTENWERKE, Germany
Project: Slab Caster</p> <p>JSW STEEL LTD., India
Project: Slab Caster</p> <p>SAIL, India
Project: Hot-Strip Mill Upgrade</p> <p>POSCO, Korea
Project: Linking of Pickling Line and Cold-Rolling Tandem Mill</p> <p>POSCO, Korea
Project: Slab Caster</p> <p>LISCO, Libya
Project: Billet Caster, Bloom-Caster Modernization</p> <p>CORUS, Netherlands
Project: Slab Caster</p> <p>MITTAL STEEL POLAND, Poland
Project: Color-Coating Line</p> <p>ANSHAN ISCO, China
Project: Slab Caster</p> <p>LIANZHONG STAINLESS, China
Project: Stainless Steelmaking Plant with EAF, AOD Converter,</p> | <p>Ladle Furnace and Vacuum Degassing Plant</p> <p>MAANSHAN, China
Project: Continuous Annealing Line</p> <p>TAIYUAN, China
Project: Carbon and Stainless Steelmaking Plants with EAF, AOD Converters, 2 LD Converters, Twin-Ladle Furnace Slab Casters</p> <p>TANGSHAN HENGTONG, China
Project: 2 Continuous Galvanizing Lines</p> <p>ZHANGJIAGANG POSCO, China
Project: Stainless Steelmaking Plant with EAF, AOD Converter and Ladle Treatment Station, Slab Caster</p> <p>QATAR STEEL, Qatar
Project: Bar Mill</p> <p>HADEED, Saudi Arabia
Project: Hot Strip Mill Expansion Project Including Slab Caster, Galvanizing Line and Skin-Pass Mill</p> <p>CHINA STEEL, Taiwan
Project: Galvanizing Line</p> <p>ROCKY MOUNTAIN STEEL, USA
Project: EAF</p> <p>USS MIDWEST, USA
Project: Modernization of Galvanizing Line</p> |
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