

www.siemens-vai.com

metals & mining

The magazine for the metals and mining industries

Issue 2|2010

SIEMENS
V A I 

Commitment To Quality



How can I achieve infinite charging flexibility to generate any burden profile?

SIMETAL Gimbal Top® charging system for the blast furnace – the next generation of charging technology.

Assuring an optimized distribution of the burden is a key challenge for blast furnace operators to produce hot metal at uniform quality. The SIMETAL Gimbal Top® charging system enables the generation of any burden profile, irrespective of the burden input, by directing the charge to any point onto the furnace stockline. The relatively minor investment in SIMETAL Gimbal Top® results in low fuel rates by reducing the coke consumption and improving blast furnace performance – such as is already in successfully operation at TATA Steel, India. The world's first SIMETAL Gimbal Top® blast furnace charging system. For further information please visit: www.siemens-vai.com

Answers for industry.

SIEMENS
V A I 



Werner Auer

Dear Readers,

When I accepted the position of CEO at Siemens VAI in July 2010, I decided that quality would continue to be one of the key issues of our company agenda. We have always emphasized the fundamental importance of quality, as underlined by the successful completion of thousands of metallurgical projects worldwide in our company's long history. In fact, our company's reputation for quality is a decisive criterion for our competitiveness and success in the market.

However, quality is not a state of perfection that can be attained once and for all. On the contrary, it is a series of ongoing, incremental improvements to do what we do even better, and to supply ideally tailored plants, solutions and services that help our customers meet their performance and quality requirements.

Today, installed iron- and steelmaking capacities of most countries in the world are fully adequate to meet production demands. Emphasis is increasingly being placed on improving the efficiency and reliability of existing plants, manufacturing superior products, generating a higher share of value-added commodities and satisfying strict environmental regulations. Accordingly, greater demands must be fulfilled by technological processes, equipment and plants, requiring that the highest standards of technological excellence and plant design are applied. For these reasons, Siemens VAI employs a comprehensive quality management system that embraces all aspects of quality related to our company personnel, engineering, project execution, procurement, manufacturing and construction assembly. This system is the basis for assuring that the plants we supply perform as designed and fully meet the expectations of our customers.

There is no shortcut to quality. It is a commitment, an attitude, and a permanent striving for improvement. For me personally, it is an obligation to ensure that our company will maintain its reputation and standing behind the watchword "Quality Made by Siemens VAI." With my signature, I pledge our full commitment to quality at Siemens VAI.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'W. Auer', written in a cursive style.

Werner Auer

CEO of Siemens VAI Metals Technologies

QUALITY EXCELLENCE**8 We Mean Quality.**

A dedicated focus on both customer quality needs and continuous internal quality improvements is decisive for achieving excellent results

INTERVIEW**14 "A Question of Survival"**

Establishing quality as a corporate culture

8

Optimized processes and strict quality control is the basis for high-quality products

**MINING****16 MATERIAL HANDLING: Unmanned Operation Boosts Reliability**

Improvements in open-pit mining at RWE Power in Germany

20 BENEFICIATION: A New Addition for More Copper

Minera Los Pelambres continues to place its trust in Siemens

IRONMAKING**22 BLAST FURNACE: Don't Let Your Money Go Up the Chimney**

Solutions to improve the energy efficiency of hot-blast stoves

STEELMAKING**26 ELECTRIC STEELMAKING: Quality Made in Germany**

Siemens VAI dedicated to a culture of quality

30 SECONDARY METALLURGY: Steel Expert Takes Command

Secondary metallurgical process optimization

32 CONTINUOUS CASTING: Getting Close to Perfection

Next-generation process-optimization solutions in continuous casting

PANORAMA**38 CULTURE: A Symbol of the Creative Spirit Of the Ruhr Area**

Zollverein World Cultural Heritage site in Essen, Germany

ROLLING**40 INTERVIEW: Lined Up for Success**

Luiz Carlos Garcia da Silva Júnior on the new multi-line finishing rolling mill at Villares Metals S.A., Brazil

42 LONG-PRODUCT ROLLING: Measuring Eye Sees Everything

Profile measurement for long products

**COVER**

Quality is a core pillar of the Siemens VAI corporate policy. Examples of technical solutions, workmanship, plant references and internal improvements focusing on quality are presented in this issue of metals&mining.

44

Inspection of oil-film bearing bushing at the Siemens VAI factory in Shanghai, China



68

New solutions for the metals industry are developed at the Siemens VAI workshop in Montbrison, France



44 **LONG-PRODUCT ROLLING: Quality Begins with The Customer**

A long tradition of quality in long rolling

46 **PLATE MILLS: World's Largest Oil-Film Bearings**

New Morgoil bearings at the NSC Oita plate mill in Japan

48 **PLATE MILLS: Closer to the Major Markets**

In-house manufacture of the Mulpic plate-cooling system in China

50 **HOT-STRIP ROLLING: Hot-Strip Quality – Any Time, Any Place**

Technology packages for quality improvements in hot-strip mills

56 **COLD ROLLING: Potential for Continuous Improvement**

Cold-rolling technology packages for quality improvements

62 **SPECIAL PRODUCTS: Taking Reliability to the Next Level**

Siroll Heavy Duty Shapemeter

64 **MEDIA SUPPLY: Combined Expertise For Better Rolling**

Quaker Chemical Corporation, voestalpine Stahl GmbH, Johannes Kepler University Linz and Siemens VAI join forces to develop improved coolants/lubricants

66 **SERVICES: Working in Unison**

Successful spare-parts management with A-Class components

PROCESSING

68 **COLD BAND: Showcasing Top Workshop Performance**

Siemens VAI Montbrison

70 **WORKSHOP: On Target with HGC Industrialization**

Montbrison manufacturing

SERVICES

72 **INTERVIEW: Ten Years of Outstanding Caster Service**

Interview with Wilson Ferreira de Souza, Steel Plant Director at Companhia Siderúrgica Nacional, Brazil

6 **FACTS & FIGURES**

74 **AWARDS & EVENTS**

78 **PREVIEW**

DIALOGUE

79 **Contact**

Maintenance Contract Goes to Siemens VAI

Minera Peñasquito, a mine located in Zacatecas, Mexico, was opened up in recent years after large quantities of gold and silver ore were found during exploratory drilling. The mine has two 36-foot semi-autogenous grinding (SAG) mills, each with a power rating of 19.3 MW and fitted with Siemens gearless drive systems. For the period of one year, Siemens is handling all the maintenance work for the drive systems and the associated power systems, including the primary high-voltage supply and the complete medium- and low-voltage distribution. The maintenance contract will help Minera Peñasquito to increase the availability and reliability of its mills and to minimize downtimes.

The contract involves preventive and condition-based maintenance, repairs and spare-parts management. Remote diagnostic and maintenance tools make monitoring the plant easier. Stand-by service ensures that essential maintenance work is performed quickly. The maintenance contract is in the form of

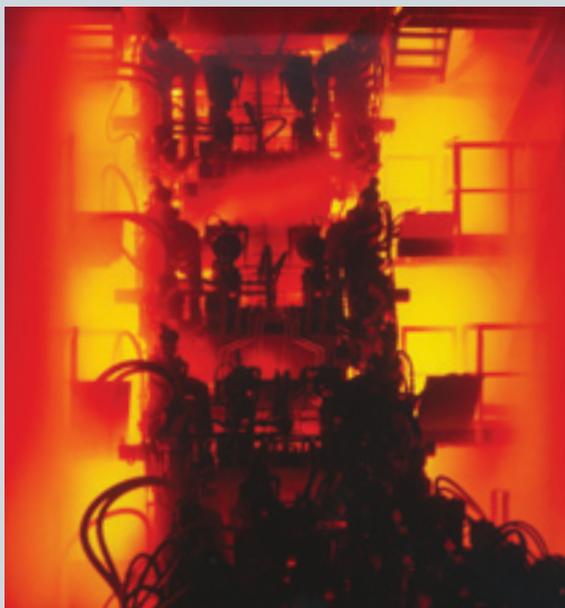


Siemens gearless drive

a performance-based agreement with corresponding payment arrangements. To this end, key performance indicators have been defined for important operating parameters, such as availability. ■

Steelworks Modernization Project in Indonesia

PT Krakatau Steel – based in Cilegon, in Indonesia's Banten province – is the largest steel producer in the country. Each year the company manufactures



Casting bow of slab caster at PT Krakatau Steel, Indonesia

some 1.5 million tons of direct-reduced iron and 2.4 million tons of steel in its electric steelworks. The steel is hot- and cold-rolled to coils and bars.

Krakatau Steel placed an order with Siemens VAI for the modernization of its Slab Steel Plant No. 1. The targets of this project are to increase the production output, lower the specific energy consumption and decrease operational costs. Siemens VAI is responsible for the design, engineering, procurement and the turnkey installation of all new and modernized components of the steelworks, and will coordinate the necessary construction activities.

Liquid steel is produced in the works by four electric arc furnaces, three of which will be completely replaced by Siemens VAI. The installation of the new EAFs also makes it necessary to modify the associated dust-cleaning systems to increase their cleaning capacity and availability.

The project also includes the revamping of two continuous slab casters (CCM 1 and CCM 2) as well as a complete renewal of secondary plant facilities such as the water-treatment plant and the oxygen, argon and compressed-air supply systems. ■

Plant Start-ups (February 1 to May 31, 2010)

Company	Country	Project
ANSC-TKS Galvanizing Co., Ltd. (Tagal)	China	FAC* received for temper mill and tension leveler
Barrick Gold Corp.	Australia	Receipt of service contract for gearless drive
Codelco, Division Andina	Chile	First upgrading of SAG* mill automation system based on new upgrading concept for Sinamics SL150
Dragon Steel Corporation	Taiwan	Start-up of 2-strand slab caster
Gerdau Acominas S. A.	Brazil	FAC received for a 230 t RH/T-COB* plant
Groupe OCP	Morocco	New service contract for data-control system in Safi
Jinan Iron & Steel (Group) Co.	China	Start-up of 4.3 m wide plate mill for production of up to 1.8 million tons of plates per year
Jiuquan Iron & Steel Co. Ltd.	China	Start-up of 110 t AOD* converter, 110 t ladle furnace and 1-strand slab caster for production of stainless steels
Lumwana Mining Company Ltd.	Zambia	Extension of service contract for gearless drives by one year
Minera Los Pelambres Ltda.	Chile	FAC received for SAG mill and ball mill
Minera Penasquito, S. A. de C.V.	Mexico	Start-up of second Siemens-supplied SAG mill; receipt of maintenance contract and Level 2 service support for gearless drives
Minera San Cristobal, S. A.	Bolivia	Extension of service contract for gearless drives for three years
Nanjing Iron & Steel Co. Ltd.	China	Start-up of process optimization system for sinter plant
Newcrest Mining Ltd.	Australia	Receipt of service contract for gearless drive
N.T.S. Steel Group Plc (Tata Steel)	Thailand	FAC received for hot-metal-charging turret
Saarschmiede GmbH Freiformschmiede	Germany	FAC received for a new VOD* cover, including drive unit. Start-up and FAC for nitrogen-blowing lance and transfer car
Shougang Qian'an Iron & Steel Co. Ltd.	China	FAC received for Lomas and Dynacon process optimization system for two LD (BOF) converters
Tata Steel Europe	The Netherlands	FAC received for continuous galvanizing line
voestalpine Stahl GmbH	Austria	FAC received for 170 t LD (BOF) converter replacements
voestalpine Stahl Donawitz GmbH & Co. KG	Austria	FAC received for Level 2 hot-stoves model for blast furnace
Zhangjiagang Rong Sheng Co. Ltd.	China	Start-up of two 180 t RH* vacuum-degassing plants, (mechanical core components, electrics, Level 1 and Level 2 automation)

*
 AOD = argon oxygen decarburization
 E/A = Electrics & Automation
 FAC = final acceptance certificate
 RH = Ruhrstahl Heraeus
 SAG = semi-autogenous grinding
 T-COB = Technometal Combined Oxygen Blowing
 VOD = Vacuum Oxygen Decarburization

Casting of beam blanks for the downstream production of high-quality structures and supports



A dedicated focus on quality needs and continuous improvements is decisive for achieving excellent project results

Commitment to Quality

Quality is a core pillar of the Siemens VAI corporate policy. It is not only an attribute of the products we sell, the customer standards we meet, or a set of principles that govern our work. It is a part of our culture, our attitude and an expression of our commitment to excellence. And a reputation for quality can only be earned through hard work – in a series of evolutionary and continuous improvement steps that never cease.

COVER STORY ^



Optimized processes and strict quality control is the basis for outstanding products



Quality is the fulfillment of the requirements of the customer." This is how Werner Auer, CEO, defined what quality means for Siemens VAI. This topic relates to the products, plants and equipment, their reliability, the materials used, consumption figures, a plant's lifetime, emission values and much more. It is important that the right level of quality be supplied commensurate with the goals and targets of a customer's investment – similar to a tailor-made suit that fits well.

Few companies are capable of supplying a full range of metallurgical plants that ideally satisfy the varying quality demands of different customers. Siemens VAI offers this capability, extending from cost-driven, fit-for-use, bare-bones plants that reliably and safely generate products that satisfy the requirements of standard downstream applications; to complex performance-driven metallurgical facilities incorporating the most sophisticated process models and technological packages to generate products that can be used for highly demanding purposes such as for gas pipelines and boilers.

COVER STORY >



Rigorous inspection by experienced personnel ensures product suitability for high-end applications

Quality at affordable prices

In order to meet increasing demands of certain countries and regions to produce quality products with highly economical plants, Siemens VAI is currently introducing a new concept emphasizing compact plant layout and modular machine design combined with shortest supply, installation and start-up times.

For example, producers will be able to cast good billets with a remarkably affordable caster. Efficient logistics and a maximized local supply will be the basis for a short delivery time of all caster components to the plant site. An innovative supply-chain and modular installation concept will enable erection, start-up and commissioning to be finished in record time. Not only will the billet caster be simple to operate and easy to maintain, upgrading and expansion can be carried out quickly, efficiently and in a cost-effective manner to meet growing market demands. Similar concepts are currently under development for other plant sections as well.

“Quality is the fulfillment of the requirements of the customer.”

Werner Auer, CEO of Siemens VAI

World-unique plants, exceptional technology, extraordinary products

At the other end of the quality spectrum Siemens VAI offers production facilities that are incomparable with respect to the demands placed on equipment and the high standards of the products. The following examples serve to demonstrate this capability:

In July 2010, a casting-thickness record was achieved on the jumbo caster that Siemens VAI started up at Qinhuangdao Shouqin Metal Material Co., Ltd. For the first time ever, 400 mm thick slabs were cast on a caster equipped with a straight mold. Following strand bending, all strands, including 400 mm thick formats, are straightened into the horizontal position while the core is still liquid. This is made possible by the robust design of the caster and the wide range of installed technological packages. Outstanding slabs are cast at a faster rate compared to a similar-sized caster design employing solid-core-strand straightening. The low- to high-carbon, peritectic, structural and HSLA (high-strength, low-alloy) steel grades cast are used for the production of pipes and plates in the demanding shipbuilding and petroleum industries.



First slab cast on the jumbo slab caster of Qinhuangdao Shouqin, China

In the rolling sector, a unique 4-high reversing hot-rolling mill was started up by Siemens VAI at Plansee Metall in December 2008. The rolling stand is capable of exerting more than 50,000 kN of force – the highest in the world currently employed for the rolling of refractory metals such as molybdenum, tantalum, tungsten, niobium and chromium. The mill configuration, comprising a reversing rolling stand, leveler, dividing shear, slitting machine and coiler, is fully automated from the heating furnaces to the downcoiler.

In April 2010, 0.8 mm thick strip with a width of 1,500 mm was rolled and coiled for the first time on the Arvedi ESP Line in Cremona, Italy. This is the world's first linked thin-slab casting and direct-rolling plant in which coils are produced from liquid steel in a continuous and uninterrupted process. Thin- and ultra-thin strip are routinely rolled and coiled in weights exceeding 30 tons, confirming the stable and reliable process operations of this highly compact, 190 m long production facility. A wide range of carbon and HSLA steel grades were produced to date, all of which was commercially sold. In recognition of the fulfillment of the guarantee performance figures, Acciaieria Arvedi S.p.A. issued the Final Acceptance Certificate (FAC) to Siemens VAI in February, 2010. According to Cavaliere Giovanni Arvedi, inventor of the process, “Operation of the Arvedi ESP line at Acciaieria Arvedi has fully met expectations and overall product quality is excellent.”

>>

>> **Internationally standardized quality**

A complete project package – from tender to plant start-up and commissioning – must be well planned, coordinated and implemented. Because of economic considerations, it is often not possible to centrally design and manufacture all equipment and components. This is why Siemens VAI has established an international network of engineering and manufacturing sites where high standards of know-how, skill and capability are available, and where lower local costs prevail. Ultimately, with the right training, personnel supervision and application of strict product-control standards, it makes no difference at all where a plant is designed or where the equipment is built. An intensive product focus and specialization is a driving force behind quality excellence.

“Operation of the Arvedi ESP line at Acciaieria Arvedi has fully met expectations and overall product quality is excellent.”

Cavaliere Giovanni Arvedi, Acciaieria Arvedi S.p.A., Italy

Standardized quality control of company engineering and manufacturing centers is complemented by the strict demands placed on subsuppliers to fully conform with Siemens VAI standards. Rigid



First 0.8 mm thick coil produced on the Arvedi ESP line at Acciaieria Arvedi, Cremona, Italy

screening and selection of preferred suppliers is performed so that price, quantity, delivery and quality targets can be met. Careful expediting by Siemens VAI specialists ensures that manufactured goods and equipment meet the required specifications. Furthermore, a company-wide documentation system is applied so that consistent quality is achieved on an international basis.

Commitment to quality

Siemens VAI quality and project-management expertise is the result of decades of engineering and



Headquarters of Siemens VAI in Linz, Austria – Committed to meeting the requirements of our customers

Product quality results from quality workmanship combined with careful quality control



plant-building experience that extends across the entire iron and steel production chain, from mining to the finished product. As part of the Siemens concern, Siemens VAI uniquely offers vertical integration capability for complete plants, comprising mechanical equipment, drives, motors, all automation levels, electrics, media-supply and environmental systems. This is achieved in an international network of engineering, service, workshop and manufacturing locations where the latest industrial standards of engineering and manufacturing are applied. A rigidly applied quality-control system combined with product life-cycle management and comprehensive services ensures that all equipment, systems and processes function and interact in an optimized manner. Customer production and quality targets are thus fully met by the proven capability of an experienced single-source partner.

A key focus of this issue of metals&mining is therefore placed on technical solutions and plant references that describe and demonstrate solutions that lead to improvements in plant, process and product quality. A second focus of this issue is on the quality culture within our company and the dedication to excellence by our people.

Quality is an obligation to be met. It is a fundamental factor for a long-term business partnership and decisive for common success. Siemens VAI is committed to quality. ■

Author
Dr. Lawrence Gould
Contact
contact.metals@siemens.com

Establishing quality as a corporate culture

“A Question of Survival”

Quality is gaining in importance as a competitive factor, since the success of products on the market depends on how well a market player is able to adapt to and satisfy the needs of a particular customer group. Prof. Dr. Dr. Horst Wildemann from the faculty of business administration with a focus on logistics at the Technical University Munich speaks in this interview about quality as a management concept.

Prof. Wildemann, how would you define quality today?

Prof. Dr. Wildemann: In recent years, quality has developed from a function of production into a corporate philosophy. As such, the term quality does not only denote adherence to product specifications, it incorporates all the demands made by the customer. This makes quality an important competitive factor, since the success of products on the market depends on how well a market player is able to adapt to the needs of a particular customer group. Quality is no longer just an image factor; it is becoming a question of survival that has to be considered in all management decisions. Companies have to act according to the motto: “Do the right things right, and get them right first time.”

What does that mean in concrete terms?

Wildemann: The only companies that can be successful in the long term are those that adopt this philosophy and master all three dimensions of quality – strategy, management of core processes and employee motivation. Quality as a corporate strategy is a typical top-down exercise. The company management has to want it; it has to grow from a seed in the minds of the top managers. Quality as a corporate culture, on the other hand, begins in the minds of every employee and, with regard to its introduction and permanent implementation, has a typical bottom-up character.

In discussions about introducing a universal quality management system, the term “quality excellence” is heard increasingly frequently. What does this term signify?

Wildemann: The aims of the quality excellence program are, firstly, to mobilize all employees to improve

quality at the company. Secondly, the approaches for driving innovation, productivity, logistics and sales in all divisions of the company are aligned with one another. Further aims are to universally implement a permanent, self-supporting learning and improvement process, to promote cul-

Biography

Horst Wildemann (68) is a Professor of Economics at the Technical University Munich. His work focuses on manufacturing and logistics as well as on issues of strategy and corporate planning. Wildemann is considered the greatest promoter of Kanban in the German-speaking world and the father of the German just-in-time concept. Horst Wildemann studied mechanical engineering and business administration in Aachen and Cologne. He worked as an engineer in the automotive industry before obtaining his doctorate (Dr. rer. pol.) in 1974 and completing his habilitation in 1980 at the University of Cologne. Since 1980 he has taught as a full professor of business administration at the universities of Bayreuth and Passau, and since 1988 at the Technical University Munich. Alongside his duties as a university professor, he runs a consulting institute for corporate planning and logistics and is a supervisory board member for several German industrial companies. Horst Wildemann founded the Bavarian Quality Award and since 1992 he has served as the expert committee’s chair.

tural development, to speed up optimization processes in order to achieve planned results, and to cut the costs of quality.

How can the costs of quality be made transparent?

Wildemann: Traditionally, quality costs can be divided into the costs of errors, inspection and error prevention. In order to be able to carry out a cost-benefit analysis of quality management, however, the quality costs have to be categorized as “costs of compliance” and “costs of non-compliance.” While the costs of compliance contribute to the success of the company, the costs of non-compliance denote a waste of resources. The costs of non-compliance therefore have to be examined in order to optimize quality costs. These can also be influenced in areas upstream from production, such as research and development, design and prototype building. The costs of compliance also need to be considered. These include all activities related to the prevention of errors. If an optimization of the total costs is undertaken, this division into two categories allows costs to be minimized while satisfying 100% of customer requirements. This can be clearly demonstrated via the basic principle that the later an error is discovered, the higher the costs. The aim must therefore be to identify errors at an early stage in order to bring about a compromise between quality at optimal cost and a quality level in the sense of customer demands.

Returning to the concept as a whole, how can quality be assured in the long term?

Wildemann: As an executive department, quality controlling has the task

of coordinating the quality improvement efforts of the individual company divisions, providing them with information, and monitoring the economic viability of the measures. In recent times there has been a call to more effectively align the content and methods of quality management and the more economically driven controlling, and to integrate these departments with one another. This allows their contributions to be directed towards improvements in company quality and issues of efficiency. To achieve this, it is necessary to point out how quality contributes to the company's success, to translate quality goals into operational requirements, and to manage the contributions using a quality cost-benefit analysis as well as quality-related figures. Furthermore, the ability to deliver quality is necessary for all value-creation processes. ■



Prof. Dr. Dr. Horst Wildemann

© Magazine “Technik in Bayern” from the Association of German Engineers, Munich branch. The interview was conducted by Wolfgang G. Nestler.

Improvements in open-pit mining at RWE Power in Germany

Unmanned Operation Boosts Reliability



Storage and transport systems that optimize throughput times and guarantee requested quality output are an important part of advanced facilities for the transfer of bulk materials. Significant savings and improvements to get the requested material in the specified quality can be achieved through unmanned operation of stackers, reclaimers and combined machines. The answer of Siemens VAI is Simine MOM, a unique method to reliably and safely optimize reclaiming operations in unmanned operation. The patented solution achieves over 98.5% availability at lignite mines of RWE Power in Germany's Rhineland area.

RWE Power is the largest German producer of electricity with around 17,000 employees and a yearly output of 180 TWh. Lignite makes up a good third of the installed capacity and is therefore an important pillar in the energy portfolio. With its yearly excavation of around 100 million tons, RWE Power is the world's largest producer of lignite. Around 90% of the lignite excavated at the company's open-pit mines in Garzweiler, Hambach and Inden is transformed into electricity. In the last years, a dozen rail-bound stackers and reclaimers at RWE Power's Hambach and Garzweiler open-pit mines have been equipped with Simine MOM for unmanned operation.

Performance values for the modernization were verified during a test phase.

Siemens VAI entered the picture in 2002 with the implementation of unmanned operation at the stockyard of the Niederaußem power plant. The trigger for this project was the addition of a new 1 GW power station to the existing lignite power plant. The cutting-edge technology implemented for the first time in this project greatly increases efficiency and therefore leads to a tremendous reduction of CO₂ emissions. But in order for the technology to work, the lignite has to be of a consistent quality. This target could only be ensured by introducing an integrated stockpile management system that covers quality management of the stockpile together with unmanned operation of the stockyard machines. Simine MAQ, the material and quality management system for bulk material from Siemens VAI, is an integral part of Simine MOM. With the first implementation of Simine MOM in combination with Simine MAQ at an RWE Power stockyard, the goal to secure the delivery of the requested amount of lignite in the specified quality could be



Reclaimer at Niederaußem stockyard equipped with additional sensors for unmanned operation



achieved. The availability of the equipment in driverless mode reached over 98.5%, which meant that for the long term the stockpile machinery could be operated without personnel.

Automatic operation in Hambach and Garzweiler

With the experience gained in the first project, RWE Power again awarded Siemens with the implementation of unmanned operation in the stockyards of the open-pit mines at Hambach and Garzweiler. The lignite excavated at the adjacent open-pit mines is temporarily stored at the stockpile facility before it is transported by train or on conveyer belts to the different lignite power plants and finishing plants. The stockyards are made up of two stockpiles, which can >>

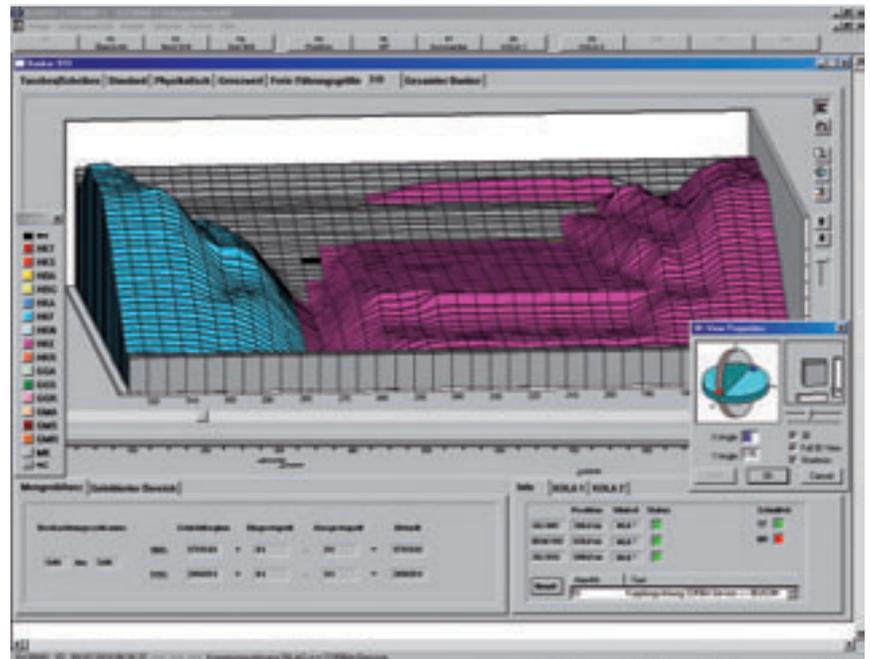
>> hold up to 400,000 tons of lignite. Each stockpile is 800 m long and divided into several sections for different quality levels. The average daily intake of the power plants and finishing plants is 140,000 tons of coal per open-pit mine.

A special challenge for both stockyards was commissioning unmanned operation of the stackers and reclaimers during running operation. The optimization of the stackers and reclaimers in unmanned operation as well as the training of the operating personnel in the control room took place during running operations. All required performance values for the entire modernization were verified and reached during a test phase. The implementation of the unmanned operation was finalized in 2008 for the stockyard in Hambach and in 2009 for Garzweiler.

mathematical algorithms for each stacking or reclaiming method. For the initial image of the stockpile and the case that the volume scanners mounted on each device fail, the height in the model can be measured and updated by a laser scanner.

For unmanned operation, the control-room personnel specifies working area and parameters for each job based on the model described above. A 2D view of the 3D model provides the possibility to select the desired working area, type of job and device. Further necessary operation data for the unmanned operation job are calculated automatically and, after approval by the operator, the new job is transferred to the device itself. During execution of the job no additional support from personnel in the central control room is necessary.

A 3D view of the Simine MAQ system in the Hambach open-pit mine. Lignite grades are represented in different colors



Storage management based on a 3D model

A core component of Simine MOM unmanned operation is the 3D model of the stockpile. The model was implemented in a separate project before the introduction of Simine MAQ for material and quality management in the stockyards of Garzweiler and Hambach. The material parameters of the lignite necessary for quality tracking by Simine MAQ are integrated in the 3D stockpile model up to cubic-meter accuracy. Based on the current position of the stacker and reclaimer and the current stacked or reclaimed volume measured on each stockpile device, the model is updated continuously using mathe-

Additional operational support for the personnel in the central control room, like interrupting a running job, initiating a new job for the same device and restarting an interrupted job, is provided. This reduces the necessary support for the unmanned operation to a minimum.

Along with the core components of Simine MAQ and Simine MOM like stockpile management as well as job management for the unmanned operation, all status information from the new unmanned operation mode were integrated in the central stockyard control system based on Simatic PCS7.



Photos of the stockpile at the open-pit mines Hambach

Railbound bucket-wheel excavators reclaim the lignite from the stockpile to the following conveyor system to transport the material to the train-loading station



The success story continues

In the last few years, RWE Power awarded Siemens VAI with further projects. For example, Siemens equipped the new Garzweiler II mine, an extension of the Garzweiler mine, with a new DCS system based on Simatic PCS7 including a new central control room and several other systems like video, communication network OTN, simulation and training systems, which are all necessary for operation of the mine. The electrical equipment for the new conveyor system for the extended mine was also delivered. The successful implementation of the new control system at Garzweiler II and RWE Power's positive ex-

perience with the Siemens VAI regional mining competence center in Cologne were among the drivers that led to the order for the control system and conveyor system for the extension of the company's Inden mine. ■

Author
Hans-Jürgen Seger
Contact
mining@siemens.com

Minera Los Pelambres continues to place its trust in Siemens

A New Addition For More Copper

Since January 2010, Chile's Minera Los Pelambres has increased processing capacity for copper ores – thanks to a new semi-autogenous grinding mill and a new ball mill, both equipped with Siemens gearless drive systems. Siemens already equipped two mills for Los Pelambres in 1999 and has been responsible for maintenance of the conveyor-belt equipment for more than ten years.

MINING >



Siemens gearless drive

In 2009, Minera Los Pelambres, an operation of Antofagasta Minerals plc, produced 311,600 tons of copper concentrate and 7,800 tons of molybdenum. The new ore-grinding mills that went online at the beginning of 2010 were built as part of an expansion program aimed at increasing copper production by approximately 100,000 tons. Siemens supplied the gearless drives for a 36-foot semi-autogenous grinding (SAG) mill with a rated power of 15 MW and a 26-foot ball mill with 15.5 MW of rated power.

In contrast to gear motors, gearless drive systems feature higher system efficiency of up to 5% and the highest levels of torque utilization, because mechanical parts between the motor and the mill are eliminated.



These GD motors in the Simine Mill are connected directly to the grinding drum. A cyclo-converter with transvector control ensures exact settings of the motor's operating point and highest efficiency also in the partial-load range, for example to process changing material hardness or to realize various modes of operation.

Simple control of inching and creeping modes lets mill maintenance procedures be set up quickly without endangering the safety of the staff. When Simine Mill GD is in inching mode, one rotation of the mill is all that is needed to achieve the exact angle that was preset by the operator, and it is not necessary to repeat the procedure. At the end of the inching operation the mill stops with balanced charge. During the creeping mode with 0.3 rpm, the operator can directly control the mill while observing the mill and the material. The result is shortened maintenance times.

Frozen Charge Shaker: optional

All gearless drive systems can be equipped with the patented Frozen Charge Shaker, which enables controlled detachment of hardened charges stuck in the mill shell. Manual cleaning is no longer necessary. The Frozen Charge Shaker lifts the charge to an uncritical angle and moves the mill in a harmless range with varying speed and acceleration. The angle and movement are designed to break the frozen charge.

Siemens VAI has years of experience in the supply of gearless drives.

In more than 40 years, Siemens has installed over 36 mills with a total of 820 MW installed power and has provided more than 36 solutions for optimal productivity. This track record is proven by over 335 machine years of successful operation time with more than 99% drive availability. By continually applying innovations, Siemens ensures that gearless drives will provide even higher availability and that they will be more productive and more economical in the future. ■

Author
Daniel Schmid
Contact
mining@siemens.com

Stoves plant at Dragon Steel Corporation, Taichung, Taiwan



Solutions to improve the energy efficiency of hot-blast stoves

Don't Let Your Money Go Up the Chimney

The blast-heating process is one of the largest energy consumers in a steelworks and also one of the leading sources of CO₂ emissions to the atmosphere. Much can be done to optimize stove performance with respect to overall blast furnace economy and energy consumption. Siemens VAI has developed several techniques that allow blast furnace operators to increase the efficiency of their stoves and thereby lower fuel costs.

Reducing the consumption of expensive metallurgical coke in the blast furnace process is now more important than ever. Coal injection into the furnace through the tuyeres can reduce coke requirements by 50%. A higher blast furnace capacity can be achieved with increasingly higher blast temperatures. The challenge for the stoves plant is to provide these temperatures at acceptable capital and operational costs. A full process evaluation that looks at the entire blast furnace performance and takes into consideration various criteria such as stove capabilities, plant-energy balances and other economic factors can determine the optimum solution for each location.

Reduced energy requirements with waste-heat recovery

Typically 18% of the total heat input into the stove exits through the chimney as waste gas. A waste-heat recovery (WHR) system can reclaim around half of this energy loss. The WHR process is based on recovering a portion of the sensible energy of the stove waste gas and using it to preheat the blast furnace gas or combustion air, or both. The recovered waste-gas heat reduces the total amount of energy required by the stoves and allows the temperature of the stove-burner flame to be increased, which significantly lowers the required enrichment-gas rate. Furthermore, a higher flame temperature results during preheating, reducing the required amount of enrichment gas if the same flame and dome temperature are to be maintained. The layouts of two types of waste-heat recovery systems are shown in Figures 1 and 2.

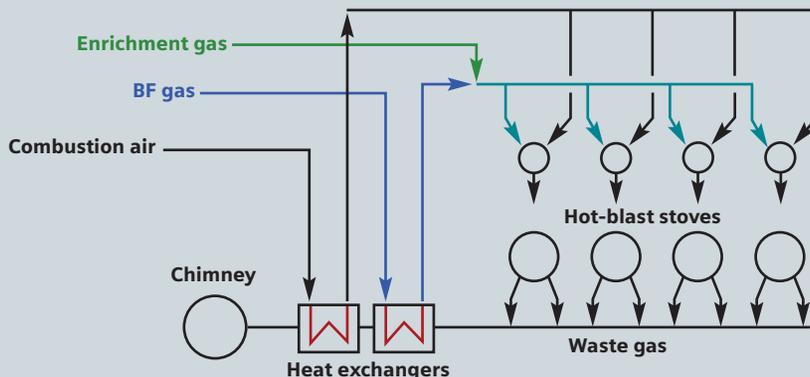
Combustion-air requirements decrease with the installation of a waste-heat recovery system. This decrease is a result of the reduction in the enrichment-

gas rate, which requires more oxygen per unit of energy than the leaner blast furnace gas (BFG). The project economics for a WHR system depend on the stove-wind rate, hot-blast temperature and stove capacity in addition to the pricing of the blast furnace gas, enrichment gas and coke. Siemens VAI offers initial stove-simulation computer modeling to determine the potential benefits of a proposed WHR system. The evaluation involves the appropriate iterations to define the stove conditions and required heat-exchanger performance.

Cost reductions with stove-oxygen enrichment

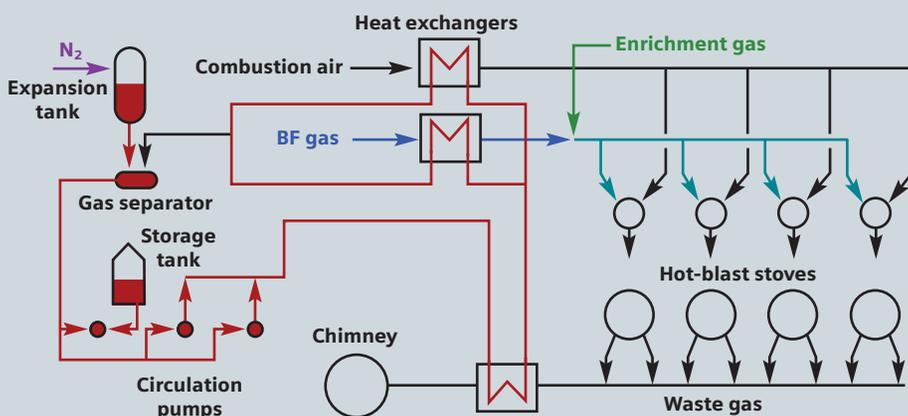
The flame temperature required to meet the dome temperature setpoint can be met by adding pure oxygen to the combustion air instead of using enrichment gas, which significantly reduces combustion-air requirements. Each Nm³/h of oxygen replaces nearly 5 Nm³/h of combustion air. Although the required flame temperature can be reached with the enriched combustion air, the total heat input is reduced when the enrichment gas is removed. The additional heat input is made up by firing additional blast furnace gas.

The net impact is a decrease in the enrichment-gas firing rate, an increase in the blast furnace gas-firing rate, and a significant decrease in the combustion-air-flow rate. The total quantity of flue gas is reduced slightly. This occurs because the BFG fuel components (CO and H₂) actually require less oxygen per unit of energy released compared to natural gas. There is no difference in stove performance as long as the combustion gases are delivered at the same flow rate and temperature. In all cases, the enrichment gas is removed and enough oxygen is added to the combustion air to maintain the same flame temperature. The >>



- Preheating of combustion gas and air to 150°C–180°C
- Economical design
- Location dependent on gas and air mains
- Installation ideally suited to new plants

Fig. 1: Direct heat-recovery system with heat pipes (gas/gas system)



- Preheating of combustion gas and air to 150°C–170°C
- Less economical than direct heat-pipe systems
- Location near mains not essential
- System suitable to retrofit existing plants

Fig. 2: Indirect heat-recovery system with oil pipes (gas/oil system)

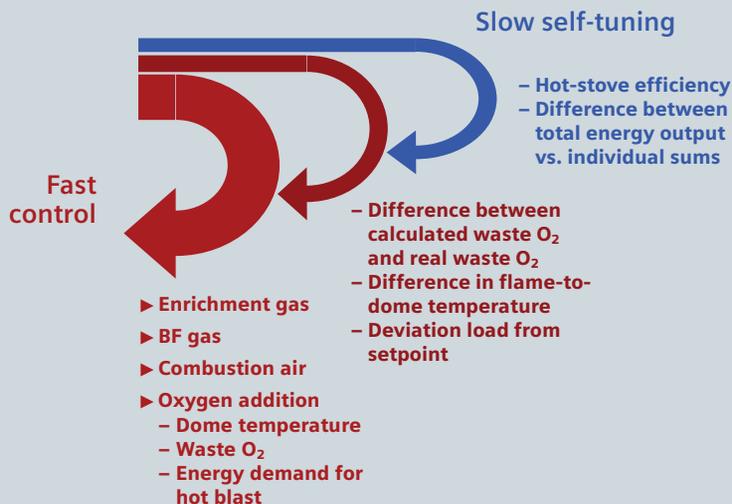


Fig. 3: Automation of hot-blast systems with self-learning control

>> BFG firing rate is then increased, maintaining the same air-fuel ratio, until the total heat input equals the base condition. The total flue-gas flow remains relatively constant, which results in a constant convective heat-transfer coefficient in the stove checkers.

The project economics will depend on the stove-wind rate, hot-blast temperature, stove capacity, oxygen pricing and costs for the blast furnace gas and enrichment gas. The capital cost includes the oxygen-supply skids, spargers and local piping tie-ins as well as the changes to the stove-firing control system. Consideration also has to be given to any requirements for increasing oxygen production at the supplier's plant.

Improved performance of older stoves

There is an additional situation where stove-oxygen enrichment can help improve stove performance, namely by allowing the hot-blast temperature to be increased in old, damaged stoves with excessive pressure drops that limit the hot-blast performance. Stove oxygen enrichment can help when 1) the stoves cannot be fully heated during the firing cycle, indicated by final waste-gas temperatures below the design maximum, and 2) stove firing is limited because the combustion-air fan cannot deliver enough air to compensate for the stove-pressure drop, as indicated by surging fan operation and/or high stove-pressure drops. The required amount of combustion air to fire the stove at a given heat-input level is reduced accordingly.

Optimization of the stove-heating process

Level 2 automation systems have the capability to detect faulty measurements and make setpoint corrections to optimize the stove-heating process. The new systems also focus on maximizing the hot-blast temperature while minimizing energy consumption and operating costs. Thermal models are used to determine the required heat input and flame-temperature requirements. In particular, the models determine the minimum dome temperature necessary to develop the required hot-blast temperature, which allows the required amount of expensive enrichment gas to be minimized. The models also monitor the energy input and output trends to fine-tune stove operation and thus protect a stove from over- or underheating.

Modern Level 2 control systems combine short-term direct control and longer self-tuning control as illustrated in Figure 3. Rapid control is used to correct the firing rate with respect to maintaining the proper stoichiometric ratios, heat-input rates, dome temperature, waste-gas temperature, waste-gas oxygen, etc. Rapid control also reduces CO₂ emissions and maximizes stove efficiency. An intermediate feedback control system allows measurement errors to be de-

termined as the basis for carrying out accurate firing corrections. Long-term trends are monitored to optimize stove efficiency performance. Corrections are made when the overall heat storage is trending high or low. The self-learning behavior enables measurement errors to be identified and corrected, and even allows the stoves to be controlled if an instrument is defective by incorporating and evaluating all other pertinent stove-operation information.

Modification of existing control systems

Stove energy efficiency can also be improved by modifying existing control systems. Many current systems provide stove-firing control routines to “automatically” control the blast furnace gas, enrichment-gas and combustion-air-flow rates to meet heat input, dome temperature and enrichment-gas setpoints. However, these setpoints often require significant operator input, which may lead to divergent operating concepts from operator to operator. There is therefore an increased risk of unstable operations, elevated energy consumption and higher overall operating costs. Opportunities to garner large savings by reducing dome temperature and enrichment-gas usage are often overlooked when a stove is operating below its maximum design capacity.

Relatively simple modifications to existing control systems can be made to improve the operational cost efficiency of stoves. With the modified control system, which is basically a spreadsheet based on stove-modeling results that is added to the control screen, the operator inputs the basic requirements such as the hot-blast temperature, wind rate, heating value of the blast furnace gas and cold-blast temperature. The spreadsheet then calculates all the firing setpoints for the operator to utilize and always compares the enrichment-gas rate and the overall total fuel cost to inform the operator about the lowest-cost option. The spreadsheet model also provides a correction function to assist the operator in making setpoint corrections when actual measurements are known to be incorrect.

In addition to optimizing operation of existing stoves, it is also very important to get the best return on any repair or replacement. Alternatives with relatively small differences in upfront capital costs can have tremendous long-term differences in operating performance, energy consumption, blast furnace coke rate, CO₂ emissions and other factors. ■

Authors

Mike Fletcher, Peter Martin

Contact

blastfurnace.metals@siemens.com

Siemens VAI dedicated to a culture of quality

Quality Made in Germany

STEELMAKING >



Precision workmanship on the current-conducting electrode arm



Bird's-eye view of the workshop

Manufacture of VOD roof in Willstätt-Legelshurst



For more than 40 years, electric arc furnaces, ladle furnaces and components for vacuum technology like VD/VOD, RH and DETEM plants have been developed and manufactured at the Siemens VAI site in Willstätt-Legelshurst. "Quality Made in Germany" has secured the manufacturing center in Southern Germany a position as a world-leading supplier for electric steel-making technology and automation.



Valve stands – a core component manufactured at the Willstätt-Legelshurst workshop

Siemens VAI Germany has around 330 employees at the Willstätt-Legelshurst location. Under a normal workload, 93 employees work in the three halls that cover an area of 6,800 m², which equates to a yearly manufacturing capacity of 90,000 hours. This rate can be doubled as needed by outsourcing production to longtime partners that hold a wealth of experience and technical knowledge.

Gerold Schaub, the head of production, sees a big competitive advantage in linking development and production at the Willstätt-Legelshurst location: "The advantages of CAD/CAM can be fully exploited." Schaub goes on to point out that in-house production ensures quality standards are fully met – even when components in customers' facilities have to be replaced immediately after being damaged or when substantial damage is detected during inspections. "Continual assessments ensure that customers always get the best solution in the quality they expect," says Schaub. In-house production and development also has the advantage that in the development of new products and components, new methods can be easily implemented and tested with a minimum of time. The experience gained later flows into running production. "That's the famous continuous improvement process," says Schaub.

Fifty important core components

High-current systems, current-conducting electrode arms, valve stands and burner equipment as well as all oxygen technology are especially difficult

to manufacture because of their material variety. "This is where our employees' many years of experience in manufacturing components in alloy and non-alloy steels and in copper really pays off. Especially combinations of different materials are very complex and difficult to work with," explains Schaub. And this requires a lot of experience in welding. For customers the diligence pays off, since well-constructed facilities and components are highly dependable.

"Continual assessments ensure that customers always get the best solution in the quality they expect."

Gerold Schaub, head of production

Schaub explains that at Siemens VAI Germany more than 50 special core components have been identified for which certain quality requirements apply. "More than anything, quality is a mindset. That is why it is important that every employee knows what really matters. For my area this means that experts for quality assurance in welding are already included in the pre-project phase, and their involvement ends with the FAC, which is when the customer certifies that the delivered solution meets all requirements." >>

>> There is a further advantage to the Willstätt-Legelshurst location: on-site industrial training. Every year ten highly motivated and well-trained workers complete an apprenticeship at the site's own training workshop.

Quality workmanship begins in the mind

Those who come to Willstätt-Legelshurst are reminded of the current quality offensive: in the reception area of the production facility hangs a placard with the words "We are quality." All employees act according to this guiding principle by incorporating the quality claim in their daily work. "An important prerequisite is open and direct communication between management and employees," says Wolfgang Roeming, head of quality control and production acceptance. Permanent and uninterrupted production monitoring as well as coordination of planned acceptance tests are also part of quality assurance, just as correct warehousing of welding materials like technical gases and welding powders. All activities from welding supervision to quality assurance are documented.

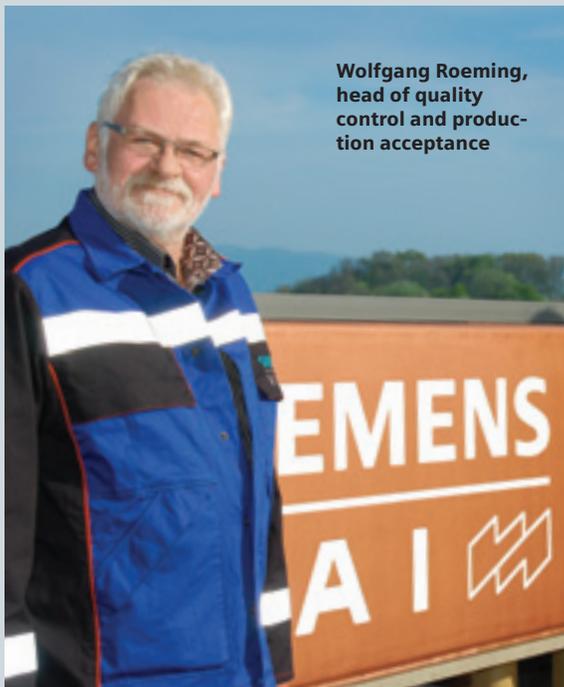
When good is not good enough

"We are currently auditing potential suppliers," says Roeming. "Only then can we ensure continuous quality improvement." This includes daily controls in a two-shift system in which the incoming goods and material certificates from raw materials like metal



Elbow section of the offgas duct of an electric arc furnace

Interview



Wolfgang Roeming,
head of quality
control and produc-
tion acceptance

In times of globalization, "Made in Germany" is still a powerful argument that often justifies the higher costs associated with manufacturing in Germany. Since the beginning of this year, the production site in Willstätt-Legelshurst has a new team responsible for production and quality. Petra Kreuder, communications manager at Siemens VAI, spoke with Wolfgang Roeming, head of quality control and production acceptance.

How are you able to continuously increase quality in production?

Roeming: We are creating a structure for permanent quality control. In the framework of this project, we are preparing job descriptions and developing qualification profiles for employees in quality assurance. At the same time we are continuing to develop reporting guidelines and to enforce quality assurance normatives as well as quality management modules and processes. It is important to have a trusting and



plates, pipes, sectional steel, etc., are examined. Here the defined testing measurements and tolerances from the construction phase are checked according to determined test steps. The results are documented and variations are sent back. A testing report is then compiled and incorporated in the facility documentation. There are also weekly controls to ensure compliance with welding specifications and the established production steps, and that even encompasses testing of the coating-film thickness.

“Our next goal is to increase worldwide expert knowledge and to train employees to take on monitoring tasks at production sites in China, India and Eastern Europe. This way we can be assured that everywhere and at all times our products and solutions fulfill the guaranteed quality standards,” explains Roeming. ■

Authors

Gerold Schaub, Wolfgang Röming

Contact

electricsteelmaking.metals@siemens.com

Another quality product ready for dispatch



open work atmosphere between production and quality assurance. We are also training our employees to become welding experts by introducing them to new testing methods and by putting into practice the principle of self-monitoring in the production halls.

Can employees see how well their teams are performing?

Roeming: Yes. Every month each team is presented with a report that shows the production workload, quality assurance analyses, feedback reviews, and additional costs incurred by manufacturing defects and the frequency of errors. This way everyone in a team is informed about the team's performance.

Another area is continuous auditing. What does this entail?

Roeming: In Willstätt we want to expand our production capacity and manufacture more components for secondary metallurgy. This means that we also produce welded constructions that are subjected to static and dynamic loads and that can only be manufactured according to DIN 18 800-7.

For verification of suitability in group E, welding quality assurance for the manufacturing site and the company have to be established. That is why our welding engineers and experts and the welders themselves attend training on a regular basis. With this proof of suitability we can also review external producers without the support of outside bodies like DVS and TÜV. A further important certificate that our plant holds is HP 0 AD 2000 / EG 97/23 for the planning, manufacture and installation of steam, gas, fluid and hydraulic systems. Based on this certification we are able to plan and manufacture oxygen, gas and steam control systems, valve stands and T-COB lances.

What does quality mean for you personally?

Roeming: I think quality is about customer satisfaction and as few feedback reports from the construction sites as possible. I hope that our partners and project team members notice our efforts in quality assurance. Only when teams effectively work together can we hope to live up to the call of our CEO Bertram Junker : “Where good is not good enough because better is expected.” ■

Secondary metallurgical process optimization

Steel Expert Takes Command

Siemens VAI Level 2 process-optimization systems for secondary metallurgical facilities (SecMet) assist the steelmaker in achieving standardized and reproducible production of high-quality steel. The author tells how more than 100 Simetal optimization packages supplied worldwide by Siemens VAI are helping to optimize SecMet facilities of all kinds.



Ladle furnace control pulpit at Hadeed, Saudi Arabia



Siemens VAI-supplied 250-ton ladle furnace for a Middle Eastern steel producer

Siemens VAI offers a comprehensive series of Level 2 automation packages, marketed under the brand name Simetal Optimization. These are ideally suited for installation in all existing or new steel-making facilities, including LD (BOF) converters, electric arc furnaces, ladle furnaces, ladle treatment stands and vacuum-degassing plants. These packages are comprised of so-called Steel Expert process models, process-tracking modules and the associated HMIs (human machine interface). The optimization of SecMet processes involves control of basic production functions covering the handling of production plan data, assignment of quality requirements and process tracking. Steel producers are thus assured of obtaining heats that strictly follow the production plan and fully comply with the targeted steel-grade definitions.

Steel Expert continuously informs operating personnel about the overall state of the heat (i.e., weight, temperature and analysis) during treatment. All model calculations are performed based on the actual steel condition without having to take samples after each material addition. Heats are released to the casting machine on schedule, and the target chemical analysis is consistently achieved with high accuracy.

Process optimization with advanced models

Process models are started according to the actual treatment phase. Process-optimization systems determine

process setpoints by combining predefined instructions with model results. Siemens VAI Steel Expert process models guide production from ladle takeover until transfer to the next production step. The objective of the model package is to release a heat exactly in accordance with the defined temperature and chemical composition as required by the production plan. Whereas the Steel Expert Supervision package is comprised of cyclic models and oversees the metallurgical progress and actual status of the steel during treatment, Steel Expert Setpoint models are used to calculate the materials to be charged and the energy required for heating.

Process-supervision models

The Steel Expert Supervision cyclic model package comprises different modules for metallurgical and thermal calculations. Based on mass and energy balances, the model takes into consideration thermodynamic and physical/chemical reactions as well as the resulting enthalpies. From the start of treatment, Steel Expert cyclically calculates the current state of the steel bath with respect to the temperature, weight and chemical analysis of steel and slag.

The cyclic metallurgical model of Steel Expert Supervision calculates the changes in slag and steel-bath analyses as a result of reduction and oxidation reactions, the degassing of H, N, O, and C under vacuum conditions, and other effects such as carbon pick-up due to arcing. Finally, the cyclic thermal model balances energy input and all energy losses that stem from radiation, stirring, offgas and bath-surface losses, allowing the actual temperature of the steel bath to be periodically calculated.

At the start of treatment, the model initiates the calculations according to the available heat information from the previous production unit. The result of each cyclic calculation represents the actual condition of the heat and forms the basis and input for the next calculation cycle. Information received from the basic automation system is considered, including stirring or lift-gas information, electrical or chemical heating, the type of material added to the ladle or vacuum vessel, and all measured values (Celox, Hydris, steel sample, slag sample).

Each model calculation starts on the basis of the calculated steel condition at the current time, regardless of whether a sample or temperature measurement was taken since the last material addition. This feature reduces the number of samples required during treatment.

Metallurgical setpoint models

Metallurgical setpoint models are applied for fine adjustment of the chemical analysis and the temperature

Main benefits

The operational benefits and advantages that can be derived from Steel Expert process models include:

- Continuous operator information about the state of the heat (weight, temperature and analysis) during the entire treatment process
- Performance of all calculations on the basis of the actual steel condition without the need for sampling
- Release of heats to the next production unit on schedule
- Achievement of the target chemical analysis with a high degree of accuracy
- Up to 15% cost savings for alloying materials, as recently shown during steel-plant operations
- Reduction in temperature probe expenses

of the steel bath. Processing steps during secondary metallurgical treatment include deoxidation, alloying, desulfurization by charging slag additives or by powder injection, inclusion shape control, slag saturation, oxygen blowing for decarburization, and temperature control (electrical/chemical heating or cooling).

The Steel Expert Setpoint model calculates the types and weights of materials to be added, taking into account the actual and target steel analysis and temperature. Metallurgical reactions between steel and slag following the addition of material up until the scheduled ladle-departure time are considered in order to reach the target analysis at the correct point in time. If several materials are available for alloying, the model selects a cost-efficient material combination. Special treatment of certain elements and materials can also be handled by the model. Elements or materials may be set to some fixed or current value, assigned to a minimum or maximum figure, or designated as “forbidden” and not to be optimized. Furthermore, this alloying model also allows various property restrictions to be accounted for, such as steel hardness and Jominy functions.

The ideal process-optimization solution is proposed by Siemens VAI automation specialists on the basis of existing site conditions, production targets and budget restraints. The described solutions typically pay for themselves within a short period of time ■

Author
Stephan Hofinger
Contact
automation.metals@siemens.com



Next-generation process-optimization solutions in continuous casting

Getting Close To Perfection

Siemens VAI offers a comprehensive range of technological packages and process-optimization models that cover all aspects of the continuous casting process. Well proven in hundreds of casting plants worldwide, these solutions help to increase caster performance, plant availability, product quality and machine flexibility. Simultaneously, operating and maintenance costs are reduced. In the following, four examples of recent next-generation process-optimization models are presented.



Intermix is a sophisticated process model capable of evaluating the composition of mixed steel grades that are the result of sequence casting. On the basis of this information, the product disposition of affected strand sections can be determined quickly and reliably.

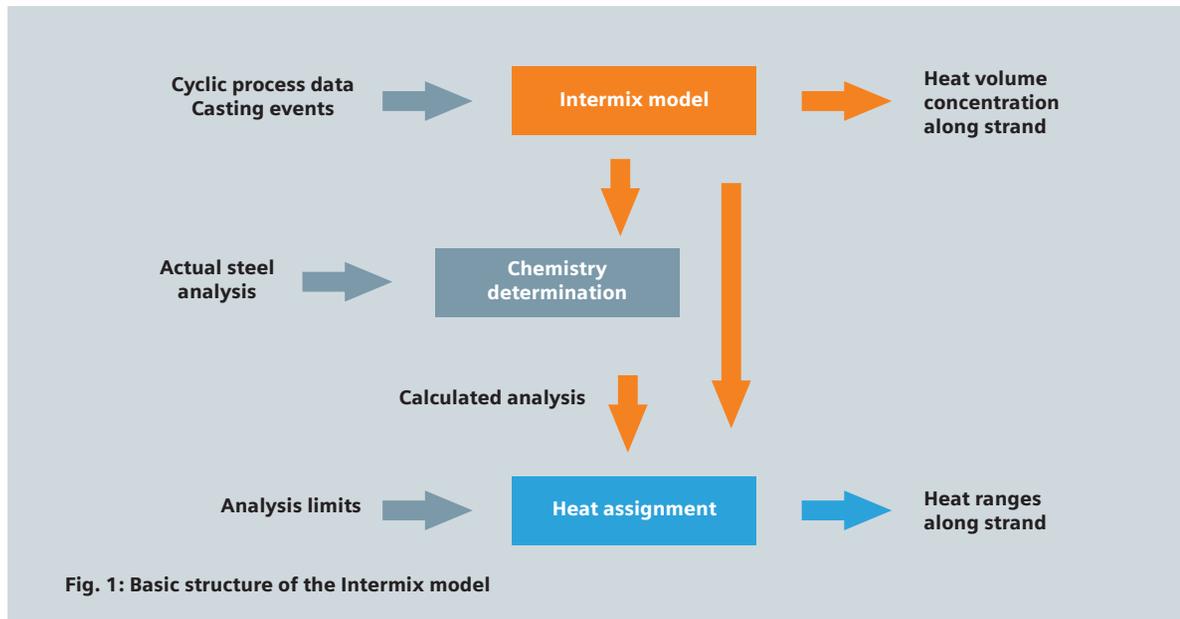
With the fully automatic and dynamic Dynacs 3D secondary cooling model, the stand-temperature profile and the required secondary cooling-water quantities can now be more accurately calculated at any position along the strand.

Highest internal strand homogeneity for the production of superior-quality slabs is made possible with improved DynaGap Soft Reduction technology. In accordance with the Dynacs 3D-calculated setpoints, precise adjustment of the roller taper in the area of final strand solidification is made possible. This contributes to a decisive improvement in product quality.

The VAIQ quality-control system allows quality deviations from target values to be detected as early as possible in order to take appropriate rectification measures.

Intermix – know the steel you’re casting

During sequence casting, a mixing of steel grades takes place in the tundish and consequently in the strand with each ladle change. On the basis of the chemical composition of the steel, Intermix calculates whether the mixed steel zones may be used for the foreseen product application, or if the steel has to be downgraded or even scrapped. Information acquired from tundish flow experiments combined with analysis results of steel samples taken from solidified products ensures a high degree of accuracy of Intermix predictions with respect to the actual composition of the mixed steel zones .



Intermix references and orders (examples)		
Customer	Country	Caster Type
Acciaieria Arvedi	Italy	ESP plant (endless strip production)
ArcelorMittal Carinox	Belgium	1-strand stainless steel slab caster
ArcelorMittal Eisenhüttenstadt	Germany	2-strand slab caster
BlueScope Steel	Australia	2-strand slab caster, 2x1-strand/twin-slab caster
Cosipa	Brazil	2-strand slab caster
Deutsche Edelstahlwerke	Germany	6-strand billet caster
Georgsmarienhütte	Germany	6-strand billet caster
Jinan ISCO	China	1-strand slab caster, 2x1-strand slab casters
Nanjing ISCO	China	1-strand slab caster
ThyssenKrupp CSA	Brazil	2x2-strand slab casters

>> The Intermix model (Figure 1) determines traces of the previously cast heat present in the current heat. Steel mixing takes place not only in the tundish but also in the mold and upper parts of the strand. Mixing in these areas is evaluated by a mixbox-type submodel of Intermix that makes it possible to calculate the chemical composition of the steel at any position along the cast strand. Tundish changes or the use of separator plates are treated individually.

Intermix calculates whether the mixed steel zones may be used for the foreseen product application, or if the steel has to be downgraded or even scrapped.

Intermix calculations are cyclically performed for selected chemical elements starting with the “ladle open event” of a new heat. The final decision about the compatibility of heats cast in sequence is performed by the heat-assignment function of Intermix. The concentration profiles of certain critical elements that have an impact on the final product disposition – prime, downgraded or outright defect – are determined. A deviation is detected if one of the critical elements does not match the steel-grade specification. Output from the Intermix model allows the yield to be maximized by applying cut-length optimization to incompatible steel areas along the strand that are designated as scrap.

Dynacs 3D – a new dimension in secondary cooling

More than 100 Simetal Dynacs secondary cooling systems have been installed in slab casters worldwide as of June 2010. The first-generation Dynacs solution, introduced in the 1990s, was characterized

by a two-dimensional temperature calculation of the strand center. The strand corners were largely neglected by the process model. Continuous improvements in computer performance have now made it possible to calculate the temperature at any point within the entire strand in real time, in a full three-dimensional mode and in a sufficiently fine discretization (Figure 2). The model is based on an explicit finite-volume approximation that solves the heat-transfer equation and takes into consideration temperature-dependent density as well as the position-specific slab thickness and width. Dynacs 3D accurately assesses the heat transfer from the slab surface resulting from radiation, heat transfer to the rolls, natural convection and spray water. Furthermore, Dynacs 3D can be applied for both spray cooling and air-mist cooling and takes into account the spray-distribution pattern of the nozzles. This ensures an accurate spray-cooling heat-transfer prediction to temperatures below 700°C when the Leidenfrost phenomena disappears. The result is an even more precise determination of the strand surface-temperature profile and the final point of strand solidification.

In addition to specifying the desired surface temperature along the strand length, Dynacs 3D enables the temperature profile across the strand width to be preset. Even individual control of the water flow and positioning of each cooling nozzle is possible. The control algorithms of Dynacs 3D

calculate the water-flow setpoints to achieve the target strand-surface temperature values.

Another highlight of Dynacs 3D is its capability to calculate the natural shrinkage taper of the strand. This enables the roll gap to be dynamically adjusted exactly according to this strand taper, minimizing the influx of excessive liquid steel into the segregation area. The result is considerably improved internal homogeneity of the strand.

The offline maintenance and setup system allows the cooling-relevant settings to be configured in such a way that the spray-water distribution in the cooling zones and the application of cooling practices are optimized for slab and bloom casting machines. Customers' metallurgical know-how can be easily incorporated into the Dynacs 3D automation setup. A built-in offline simulation system enables comprehensive testing of new parameter settings prior to application in the production process.

The Dynacs 3D secondary cooling model has already been successfully installed in the No. 6 Slab Caster of voestalpine Stahl, Austria, as well as in the CCM 3 Slab Caster of Chinese steel producer Qinhuangdao Shouqin Metal Materials Co., Ltd.

Advanced DynaGap Soft Reduction

DynaGap Soft Reduction stands for dynamic roll-gap adjustment in continuous casting. This is made possible by specially designed strand-guide segments – known as Smart Segments – in which the roller gaps >>

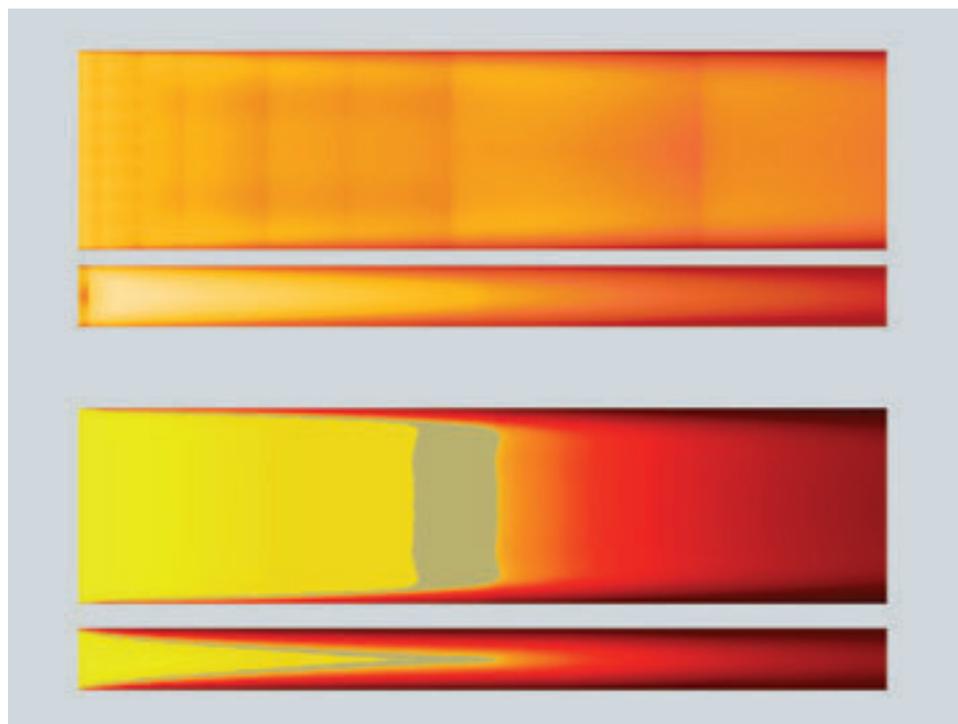


Fig. 2a (top):
Calculated temperature profile of strand surface (top and side view, true colors)

Fig. 2b (bottom):
Calculated temperature of strand cross section (center view, enhanced colors)

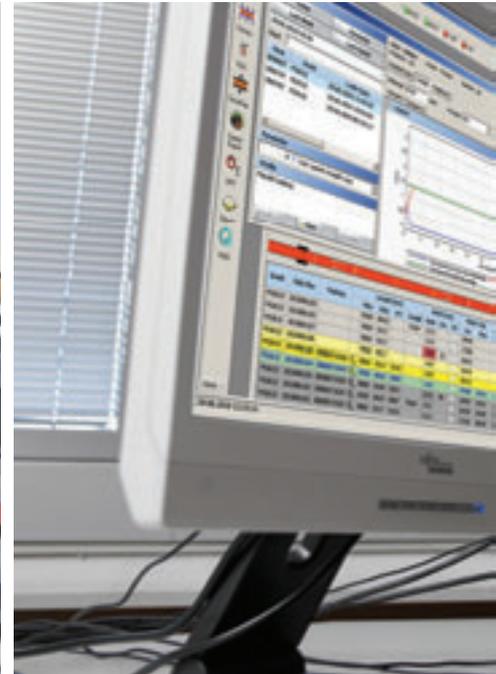
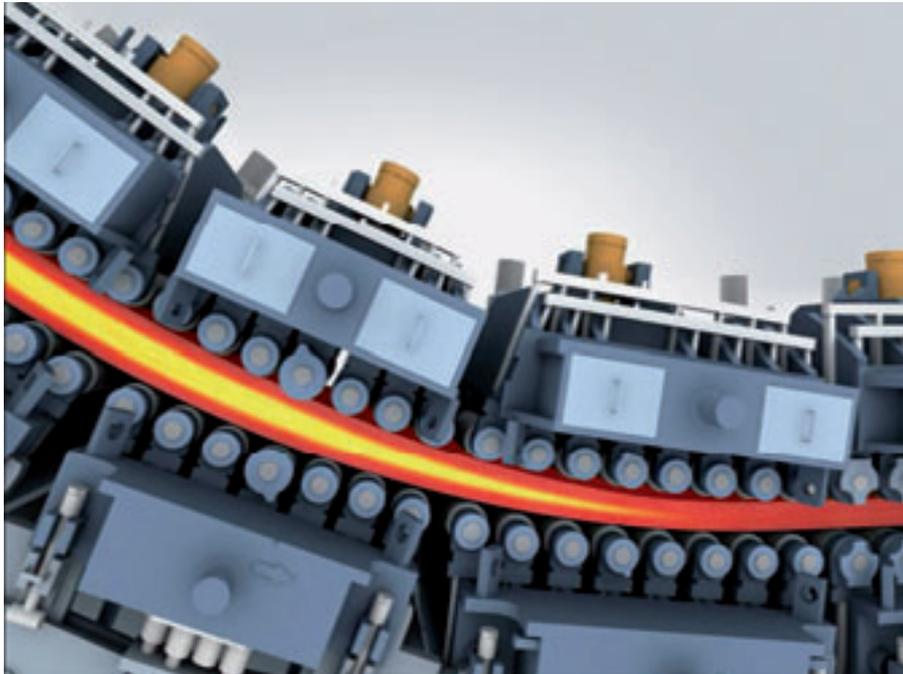


Fig. 3: Optimized adjustment of the roll-gap profile and highest internal strand quality with DynaGap Soft Reduction

>> can be remotely adjusted for strand-thickness changes and for improved internal strand quality (Figure 3). On the basis of the online information provided by the Dynacs 3D thermal-tracking model (see previous topic), DynaGap dynamically calculates the setpoints of the adjustable roll gap.

The new DynaGap model also takes into consideration the steel shrinkage as calculated by Dynacs 3D, which allows a more precise adjustment of the roll-gap settings to be achieved. This minimizes steel flow into the liquid or mushy strand center and also results in a significant reduction of macrosegregations along the entire length of the solidifying strand. Supervision of the roll engagement, depending on the state of solidification (liquid, mushy or solid) and the calculated strand-thickness profile, is a decisive factor for precise roll adjustments and thus improved product quality. An optimized roll engagement also reduces excessive forces on the strand and decreases roller wear.

Supervision of the roll engagement ... is a decisive factor for precise roll adjustments and thus improved product quality.

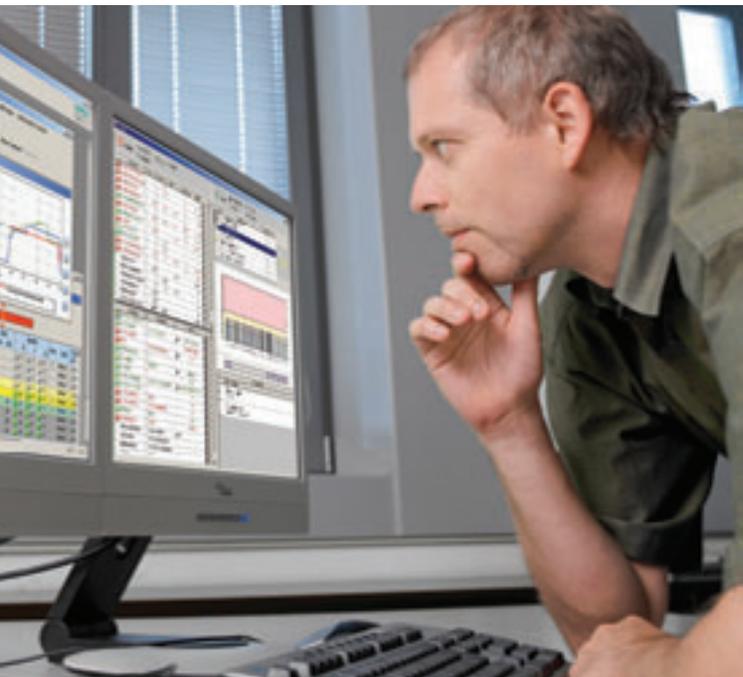
The more accurate control of the roller gaps allows additional casting strategies to be implemented such as liquid-core reduction and intentional bulging soft reduction. This further increases casting flexibility and product quality. DynaGap makes it possible to freely define start-up and tailing strategies based on the strand thickness, steel grade, casting status or other events. In this way roll damage and production interruptions, which may arise from the different casting behavior of the cold strand head or end, can be avoided.

The new DynaGap Soft Reduction model can be installed in existing DynaGap Soft Reduction systems supplied by Siemens VAI, reusing existing equipment and basic automation systems.

VAIQ – for the ultimate in steel quality

To minimize additional costs related to non-conformable quality, it is important to detect quality deviations as early as possible so that appropriate rectification measures can be taken. VAIQ addresses quality issues during the early phases of steel production – from steelmaking and refining up to and including continuous casting and product disposition. On the basis of the experience acquired from the installation and successful operation of the VAIQ system at more than 200 steel plants worldwide, Siemens VAI has developed a completely new generation of VAIQ to further improve quality supervision.

VAIQ determines the necessary process setup for quality-related process parameters, tracks the actual



A new generation of VAIQ for even better quality control in steelmaking and continuous casting

process parameters during production, predicts the quality of the liquid steel and cast products, and automatically determines subsequent product disposition. The latest generation of VAIQ improves the functionality of the previous system and includes new operator guidance, high data-tracking resolution and a completely new flexible editor for quality rules.

Quality rules can be tested offline using input data from pre-defined test cases. This input data can be entered manually into the system or selected from real production data. Additionally, the expected rule output is incorporated into the test-case data. In this way, the method of so-called automated testing is supported, which immediately informs the user of the pre-defined test cases that have succeeded or failed. Thus, the reproducibility of quality assurance is highly enhanced. Besides executing test cases in a batch mode, stepwise execution of the rules and output evaluation after each step of rule execution is also supported. The rules are released to production after sufficient testing and applied during the steel-production processes.

Online decision support and operator guidance is facilitated by the rule-based component. This allows continuous quality ratings to be carried out on the heats approaching the caster and during casting. Operators in the control rooms for steel refining and casting are guided by the information displayed on special screens to achieve the quality goals. Furthermore, the quality rating of the steel being processed is also shown and continuously updated.

Machine-learning algorithms can be used for the generation and training of models for quality prediction. Sufficiently trained models can be run by the rules engine during steel production for the online prediction of product quality. Manually entered quality rules and automatically trained models can be combined into a hybrid overall quality-prediction model.

VAIQ features high-performance and high-resolution process-data tracking and fast rule execution to support online decision-making. In the new system version the process-data-tracking resolution was improved in such a way that each value transmitted from a Level 1 system to VAIQ is permanently recorded and a projection is supported for each value to the cast length of the strand.

Application of VAIQ leads to a number of advantages for steel producers.

The Discovery System – part of VAIQ – provides the metallurgists with a database containing general production information, process data as well as quality inspection results such as those originating from surface-inspection systems. Data that is of interest can easily be selected from the huge amount of information, and thus routine work, which is normally necessary for data collection, is eliminated. Frequently used methods for data evaluations are readily available in the system. Reports and graphs can be generated with overviews and details of process and quality. The cause-effect relationships between process parameters and quality results can be analyzed.

Application of VAIQ leads to a number of advantages for steel producers. These include improved and reliable product quality thanks to operator guidance for achieving consistent and systematic production processes; cost savings resulting from reduced product inspection and conditioning; and assured product quality during direct or hot charging when visual operator inspection is not possible. ■

Authors

Dr. Kurt Dittenberger, Dr. Peter Juza, Wolfgang Kibler, Norbert Hübner, Reinhold Leitner, Dr. Franz Ramstorfer

Contact

automation.metals@siemens.com

Zollverein World Cultural Heritage site in Essen, Germany

A Symbol of the Creative Spirit of the Ruhr Area

Blast furnaces, shaft towers, stockpiles and gas tanks are monuments to the Ruhr area's 150-year industrial past. Its transformation from industrial region to cultural mecca can be increasingly seen in the 53 municipalities that make up the greater Ruhr area and are this year collectively the European Capital of Culture. Many abandoned production sites have developed into lively cultural areas and attractive venues. The Zollverein – a Unesco World Cultural site – serves as a testament to this change.

PANORAMA >



The characteristic winding tower built in 1930 became a prototype for many central conveying systems

Until it was shut in 1986, the central shaft at Zollverein XII coal mine was regarded not only as the most modern but also as the most beautiful colliery in the world. Simple, cubical structures, the use of reinforced concrete and steel framework, and a brick façade characterize the architecture of Fritz Schupp and Martin Kremmer. With a production capacity of 12,000 tons of coal everyday, shaft XII produced as much coal as the previous four facilities with a total of eleven shafts. In the 1970s, shaft XII also transported coal from other mines not belonging to Zollverein. After the last of the economically recoverable coal supplies were excavated, workers laid down their tools for the last time on December 23, 1986. The facility, whose every detail was carefully planned by its architects, was left nearly untouched. Along with the central coking plant, built in 1961 and designed in the same style by Fritz Schupp, the two buildings represent a masterpiece of functional industrial architecture. Because of the steel crisis and the sinking demand for coke, the coking plant was shut down on June 30, 1993.

For nine years now, the central shaft XII, the coking plant and the original shaft 1/2/8 have been part of the Unesco World Cultural Heritage. Originally conceived to be used temporarily, today the building ensemble is not only being preserved but also further developed. Internationally renowned architects like Lord Norman Foster, Rem Koolhaas, Heinrich Böll and Christoph Mäckler as well as the architectural firm SANAA combine the past, present and future while fulfilling the requirements set down by the World Cultural Heritage.

The former boiler house with both upstream buildings for the high- and low-pressure compressors was renovated by the London-based architectural office of Lord Norman Foster in the framework of the International Building Exhibition (IBA) Emscher Park. In the mid-1990s the Design Zentrum moved in, and today the building houses the red dot design museum, the world's largest exhibition of contemporary design. Despite reconstruction and removal of four of the five boilers, the industrial monument still retains its original ambience. In the middle of the three-nave hall is the 23 m high stoker. From there visitors can take footbridges and stairs to the four levels where they can discover in exhibition berths mounted into the walls award-winning furniture, industrial and communication design.

Architects Rem Koolhaas and Heinrich Böll redesigned the coal scrubber so that visitors could follow the journey coal takes. A 58 m long gangway leads to the 24 m level of the coal scrubber. There the Ruhr Museum presents the fascinating story of one of the world's largest industrial regions. More than 5,000 ex-

hibits from all parts of the museum and more than 1,000 loan displays from all important museums and archives of the Ruhr area document the history and self-image of the region.

That the Zollverein lives on is best portrayed with the SANAA Building, which houses the design faculty of the Folkwang University of the Arts. The Japanese architecture office Kazuyo Sejima and Ryue Nishizawa (SANAA) further developed the architectural style of Schupp and Kremmer. A white-gray cube made of exposed concrete with an edge length of 35 m is spotted with frameless windows at irregular intervals that give no indication of where the individual floors begin and end. For its visionary building design, SANAA was honored this year with the Pritzker Prize, the most coveted architectural award. With Lord Norman Foster (1999) and Rem Koolhaas (2000), three Pritzker winners are represented at the Zollverein.



In the meantime, art and architecture dominate the mine. Already in 1992 Dusseldorf-based artist Ulrich Rückriem moved his workshop into the former locksmith's shop as the first outpost of documenta IX. Today his monumental ashlar is part of the sculpture forest on the stockpile between the mine and coking plant. The installation La Primavera from Californian artist Maria Nordman in the boiler ash tower offers an unusual spatial experience, and the Palace of Projects from Ilya and Emilia Kabakov in the coking plant's former salt depot welcomes visitors to a world of utopias and dreams.

The plant swimming pool from Dirk Paschke and Daniel Milohnic symbolizes the creative spirit of the Ruhr area. With the coking plant as a backdrop, the artists welded together two overseas shipping containers to form a swimming pool and surrounded it with sundecks made from wooden planks. And at night, the 1,000 m long coke-oven battery shines thanks to illumination by light designers Mark Major and Jonathan Speis. As such, the Zollverein is a key visual of the new, postindustrial Ruhr area where new jobs have been created for artists, architects and designers. ■

Luiz Carlos Garcia da Silva Júnior on the new multi-line finishing rolling mill at Villares Metals S.A., Brazil

Lined Up for Success

Villares Metals is a leading supplier of highly alloyed specialty and stainless steels that find use in the most demanding of aerospace, automotive, oil & gas, medical, defense, energy-generation, tooling and other industrial applications throughout the world. Siemens VAI supplied a multi-line finishing rolling mill at the company's Sumaré plant, near São Paulo, which was completed in late 2007. It comprises a straight bar line, a wire-rod line and a large-flats line, and cooling and handling facilities, and it is capable of rolling up to 85,000 tons per year of the most sophisticated steel grades (see *metals&mining* 2|2008). Luiz Carlos Garcia da Silva Júnior, Rolling Mill Manager at Villares Metals, spoke about the project, results and experience working with Siemens VAI.

ROLLING >



CCR (Compact Cassette Rolling) stands in operation at Villares Metals S.A., Brazil

What were the main reasons for your company's expansion project?

Luiz Garcia: In 2004, Böhler-Uddeholm, part of the voestalpine Group since 2007, purchased Villares Metals. The main reason for this acquisition was to maintain and expand their global leadership in several areas of high-alloy steel grades, such as tool steels. As considerable growth is expected throughout Latin America, especially in the oil & gas and automotive sectors, it was also their intention to become

the leading supplier of these specialty products in the region. A key step to upgrade and strengthen Villares Metals was to invest in a new finishing mill at the Sumaré plant, since the original Villares works was hampered by obsolete technology. With this investment, the rolling capacity could be increased by approximately 40%, productivity improved, the product portfolio expanded with respect to grades and sizes, and production processes could be concentrated at a single site.



Luiz Carlos Garcia da Silva Júnior,
Rolling Mill Manager
at Villares Metals
S.A., Brazil

Does the rolling mill supplied by Siemens VAI meet your expectations in terms of operational reliability and flexibility?

Luiz Garcia: Yes it does. Not only does the new mill meet our expectations, in some cases it even exceeds them.

What improvements resulted from the start-up of the new multi-line finishing mill in terms of product quality, tolerances and metallurgical properties?

Luiz Garcia: A dimensional tolerance of 1/3 DIN [German Institute for Standards] was achieved in accordance with contract specifications. This represents a major improvement over previous operations. On the metallurgical side, various thermo-mechanical treatment steps were successfully introduced to produce different steel grades.

Have you been able to access new market segments?

Luiz Garcia: Yes, we have. With the new multiline finishing rolling mill we now also cater to market segments that we could not access before, such as industrial knives and blades and special electrodes for welding. We can also produce coils comprising extremely hard nickel alloys. The production of so-called black bars used for manufacturing valve steel in internal combustion engines is now also possible thanks to the improved surface quality that the new rolling mill provides.

What were the key challenges that had to be overcome during the project?

Luiz Garcia: During both the civil works and equipment-installation phases several major challenges had to be dealt with. These required extensive effort and commitment from Villares Metals and

Siemens VAI personnel. All of the project activities had to be performed with a minimum of downtime in the existing mill, which kept on rolling in the very same construction area. And we were successful because ultimately there was no impact on annual production figures. However, the hot and performance tests during the commissioning phase posed the most daunting challenges. The Villares Metals portfolio consists of six different product lines for the manufacture of stainless, tool, high-speed valve, and engineering steel as well as nickel-based special-steel alloys. Each type of steel has its own unique metallurgical properties and operational requirements, so an extended period of time was needed for the testing phase in order to have all significant examples of grades and dimensions properly tested.

Why did you select Siemens VAI as the partner for this project?

Luiz Garcia: The main reason was the package of equipment and services that Siemens VAI was able to provide. The consortium that had been established to implement this turnkey project fully met the requirements of Villares Metals. Moreover, the expertise of Siemens VAI in connection with other projects for high-alloy long-rolling mills with a similar portfolio – such as the Böhler Edelstahl plant in Kapfenberg, Austria – was a key factor. The long-standing relationship between Siemens VAI and the Böhler-Uddeholm group also played a role.

How would you characterize the overall working relationship with Siemens VAI?

Luiz Garcia: It was just excellent. We sensed in all Siemens VAI personnel a keen eagerness to solve the problems as they came up, and we were impressed by their strong technical competence and effective teamwork within the consortium. Inevitably there were some situations with conflicting interests, yet common sense and sound judgment always prevailed.

Are any other investments planned by Villares Metals for the near future?

Luiz Garcia: At the moment, our multiline finishing rolling mill fully meets the needs of our customers, who are involved in the most diversified segments. Investments in the short term are therefore not currently planned. Obviously, future investments will depend on how market requirements evolve. ■

Contact

Villares Metals S.A.: www.villaresmetals.com.br
Siemens VAI: longrollingmill.metals@siemens.com

Profile measurement for long products

Measuring Eye Sees Everything

Quasi-continuous bar-profile measurements help boost efficiency and yield at rod and bar mills.

ROLLING >

The Siroll Orbis+ system in this photo is ready for production line installation



Early detection of bar variations can lower energy consumption by avoiding the production of out-of-tolerance product.

Reducing setup times and ensuring tight product-dimension tolerances is vital for the efficient operation of rod and bar mills. Both requirements call for a gauge system that is capable of measuring round, flat, square and hexagonal rods, bars and billets.

More than two decades ago, the shadow principle established itself as the standard for shape measurements: A moving bar passes through the gauge head guided by a cast-iron guide tube and is then gauged by an optical system. A sensing camera within the gauge head, located directly opposite the light source, detects the shadow image cast by the moving bar and determines the bar's diameter. Other systems on the market use static or oscillating gauges to perform the measurement (see Figure 1).

Neither one of these designs can provide the full bar dimensions, and both are prone to errors due to blind zones, resulting in lower online accuracy. Furthermore, they are not able to provide the means to monitor bar shape on an ongoing basis with continuous data feedback.

Continuous measurement using a rotating gauge

To avoid these problems, Siemens VAI developed the Siroll Orbis+ system. The system's current design is the result of several decades of technical refinement based on many proven installations. By continually rotating around the bar, the system detects critical dimensions such as bar shoulders and guide-way dimensions, and it gauges them irrespective of bar twist. Therefore, the system does not need to be installed near the final mill stand.

The optical system is also based on the shadow principle, but it rotates around the bar, constantly scanning the entire profile (Figure 1). Using an LED positioned at the focus of a collimating lens, the system produces a parallel beam of light that is projected on the zone where the bar is passing. The bar casts a shadow, which is focused onto a CCD array where the shadowed photo sites are counted electronically to provide the bar's diameter at a given angular position.

Essentially, the Siroll Orbis+ system consists of a gauge head, an interface box and an operator workstation. The head is installed in the production line, generally after the final stand, with the interface box located in a nearby protected position. Measurement data from the gauge head are transmitted to the operator workstation using a wireless data link between the head and an Ethernet network. The operator workstation is generally sited in the main pulpit and consists of a PC with a keyboard and a 19-inch color TFT VDU monitor.

The measurement head contains an air-purging system, which keeps the optical system windows clear of dust, dirt and scale, and prevents scale and water from entering the gauge with the rod. Mounted on a rigid base, the gauge is protected from the mill environment by steel covers.

An optional optical pyrometer can measure bar temperature. Using its output, all hot diameter measurements can be corrected to the corresponding values at 20°C before being displayed on the operator screen. The system's electronics are powered using an isolation transformer/voltage conditioner that ensures safety and minimizes electrical interference.

Orbis+ gauging operation

The workstation displays key dimensions at pre-set angles as well as the essential maximum and minimum dimensions both numerically and graphically. Additionally, the system can show longitudinal trends and weight per unit length (see Figure 2). The graph displays a polar plot, highlighting bar defects like over- or underfill, etc., to help quickly identify potential process problems.

Depending on the system version, the Orbis+ gauge can provide up to 400 profiles per minute with a maximum accuracy of ± 0.01 mm. System calibration is performed automatically on entering the actual dimensions for a test sample.

Precision and speed for responsive process control

The Orbis+ gauge system is capable of displaying cold corrected dimensions in real time, which helps to re-

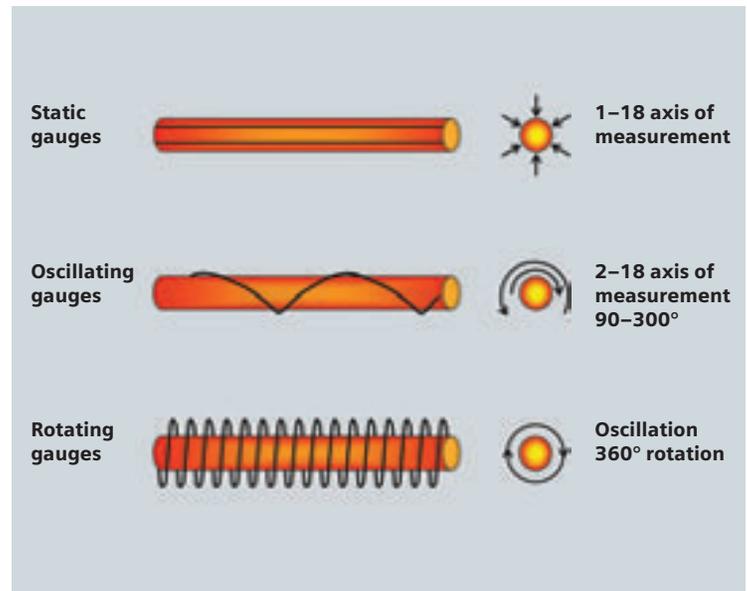


Fig. 1: The rotational measurement principle provides a 360° view of rod and bar dimensions

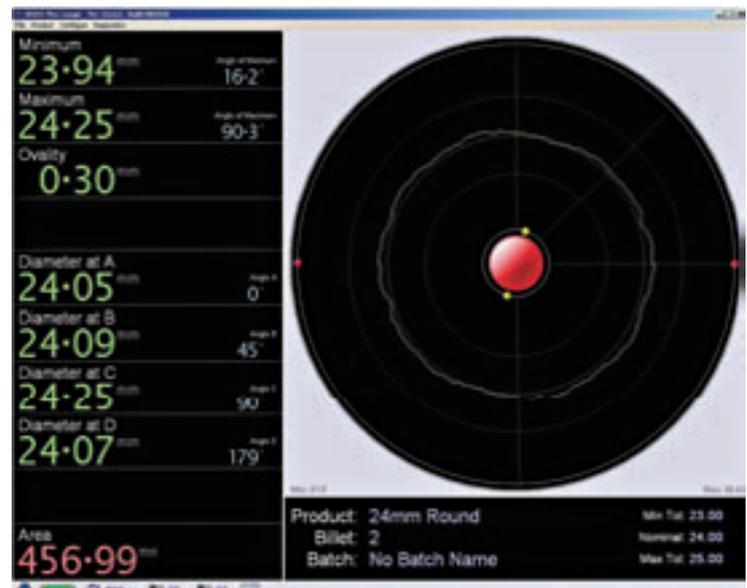


Fig. 2: The Siroll Orbis+ graphical display presents a polar plot to help quickly identify potential process problems

duce the time required to make adjustments to the mill so that even the first bar can be rolled to size. By constantly measuring product dimensions, size changes can be detected early and alarms can be triggered to warn operators. These features help to reduce scrap and avoid the production of out-of-tolerance bars. The Siroll Orbis+ system leverages a higher line efficiency with a very high and quantifiable ROI. ■

Authors

Brian Smith, Paul Pugsley, Neil Fletcher

Contact

hotgauges.metals@siemens.com

A long tradition of quality in long rolling

Quality Begins with The Customer

For employees and customers alike, the sign on the entrance door of the Siemens VAI building in Worcester, Massachusetts, sends a clear message: "Welcome to the Quality Zone." The sign may be new, but the message is well understood by all those who have passed through that door. Since 1988 there has been a quality culture within the former Morgan Construction Company, now the headquarters for the Siemens VAI long-rolling business.



Message on the entrance door of the long-rolling headquarters of Siemens VAI in Worcester, Massachusetts

ROLLING >

Customers are central to the quality process. Employees at all levels and in every department understand the Siemens VAI definition of quality – "conformance to customer requirements" – and have spent time learning what steps are necessary to reach the goal of zero defects.

"Do it right the first time is easy to say," agrees Ed Kenney, Senior Vice President of Manufacturing for the Long Rolling Business, "but this can be difficult to achieve without a wholesale change in thinking about how day-to-day work is accomplished. Employees must first ask 'What is my goal?' followed by 'What specifically prevents me from reaching it?' It's a journey of continuous improvement coupled with quality improvement," Kenney says. "Employees now recognize that they themselves – not the inspection department – are responsible for the quality of their work."

"The ultimate customer is the buyer of the company's patented high-speed rolling equipment, yet

for company employees the initial customer is the colleague down the line who handles the next step in production," notes Don Bolduc, Director, Quality Management. "The requirements must not only be clear, but clearly understood. "The less rework involved, the faster delivery times can be achieved."

Tracking the journey of roll housings offers one example of the problem-solving approach to quality. Their manufacture includes bolting and unbolting a front plate. An employee-team analysis found that the plates travel the full length of the Worcester manufacturing facility to have seven bolts attached and inspected, and then they return to the other end of the building for further boring, machining and unbolting before being sent off-site for nickel plating. Once delivered back in-house, the plates travel again to be rebolted prior to final assembly and shipment. "All told, we found the plates made six trips through the shop, which equaled one hour on a forklift truck," says Dennis McGugan, Con-

tinuous Improvement Manager and one of the first U.S. Siemens Production System (SPS) experts. And the team's solution? Move the bolting equipment – an air gun and a table – over to the machining area, color code the required parts to streamline the steps involved, and significantly reduce production time.

Customers first prompted the focus on quality. In the mid-1980s, a customer audit reported “We put out a great product, but we don't know how we do it,” recounts Philip R. Morgan, former CEO of Morgan Construction and now consultant to the long-rolling business. Morgan began the education process for all employees in 1989 and has driven the business to pursue quality through the prevention of defects ever since. Specific program names have changed over the years, but the message has remained constant: “All work is a process, a series of actions that when designed properly provide a desired result.” This message has been imparted to at least 1,000 people who have undergone training in Worcester and at company facilities in India, Brazil and China. “The beauty of the quality process,” says Morgan, “is that it's straightforward and easy to grasp.”

“All work is a process, a series of actions that when designed properly provide a desired result.”

Philip R. Morgan, former CEO of Morgan Construction Co.

Earlier this year, employees began to work through the Siemens Production System (SPS), which looks at the entire value stream of the production process, from material supplies and financing all the way through to equipment installation on the customer site. The same approach to quality applies to SPS, as teams seek to eliminate waste at every turn.

To reach the “quality zone,” one basic but essential question has to be asked: “What can we do better?” One way to find out is through FitBack, a customer feedback system that can help target specific areas for improvement. Changes in work process may occur far from the production floor, in the office or at the drawing table. SPS analysis extends from initial product innovation and engineering to prototype, sales, order fulfillment, delivery and on-site assembly.

As change occurs, the new challenge is to sustain improvement. Training at all long-rolling locations has reminded employees of the fundamental ele-



Quality improvement often begins with small steps:

Material flow can have a significant impact on the quality of a manufacturing process. Above: Before the process analysis, an unorganized pallet of material headed to the roll housing assembly area; it was difficult to identify which parts might be missing. Below: A customized skid clearly organizes all parts and helps employees quickly identify missing parts. The documented time savings: 76 minutes per housing.

ments of quality. “As the FitBack system has shown,” Kenney notes, “we have a good quality reputation in the marketplace.” The journey continues with SPS and its vision to improve manufacturing processes. Says McGugan: “If you attack the process, you can really achieve production excellence.” ■

Authors

Donald Bolduc, Allison Chisolm

Contact

longrollingmill.metals@siemens.com



Inspection of an oil-film bearing bushing at the Siemens VAI factory in Shanghai, China

New Morgoil bearings at the NSC Oita plate mill in Japan

World's Largest Oil-Film Bearings

ROLLING >

Of the many grades of steel plate rolled by Nippon Steel Corporation (NSC), those products designed for the shipbuilding industry are in particularly high demand. In response, NSC decided to increase capacity by installing a second stand at the company's Oita works. The Morgoil Bearing Division of Morgan Construction, a Siemens VAI business, was contracted to upgrade the plate mill in Oita, which is equipped with the world's largest-diameter oil-film bearings ever produced for flat mills.

The original mill stand at the NSC Oita works has the world's only bearings with sleeves greater than 1.75 m in diameter, first designed by Mesta. As part of the upgrade for the massive reversing plate mill, NSC decided to make the new stand's rolls and bearing parts functionally interchangeable with those in the existing stand. Because NSC did not want to be constrained by the 1970s-era bearing technology of the existing stand, early in the

design process the engineering team partnered with the Morgoil Bearing Division of Morgan.

After analyzing the existing equipment at the Oita works, the Morgoil engineers proposed a number of design and manufacturing improvements, all of which were accepted. Gabriel Royo, Vice President of MS Rolling Services and Morgoil, comments: "Thanks to our oil-film bearing know-how, an older mill with an outdated, non-Morgoil bearing could

be transformed into a 21st-century bearing with significant capacity, operational and maintenance advantages. A tailored solution like this is a hallmark of the Morgoil Division.”

Custom conversion solutions

The sealing system was converted into a customized neck-seal arrangement. Simultaneously with a reduction in the maintenance time and a decrease in maintenance costs, the conversion allows a larger turndown of the backup rolls and extends their service life by more than 10%.

Locking systems, which hold the bearing onto the back-up roll, are an important upgradeable part of the bearing assembly. A unique hydraulic lock was designed to mount the bearing quickly and safely. This eliminated the need for an overhead crane to tighten the lock, which the prior design had required. The design of the radial bearing components (sleeves and bushings) was also updated with modern lubrication features.

“Thanks to our oil-film bearing know-how, an older mill with an outdated, non-Morgoil bearing could be transformed into a 21st-century bearing with significant capacity, operational and maintenance advantages.”

Gabriel Royo, Siemens VAI

The sleeves, featuring an outside diameter of 1.70 m, are the largest in the world. They were ground using Morgoil proprietary sleeve-grinding technology. This resulted in a wall-thickness variation of less than 5 microns. The new sleeves are significantly more precise than the old sleeves, and full interchangeability was maintained.

The bushings were manufactured using Morgoil’s own circumferential Babbitt welding process. This allows for a controlled deposition of different white-metal bearing materials with excellent consistency and high quality.

Global supply capability

Despite the size of the components and the relatively short delivery time, Morgoil was able to meet

the stringent supply schedule of NSC. The locking and sealing components were made at the Morgan facility in Worcester, Massachusetts, where engineering was also performed. The sleeves and bushings and all of the external static components were manufactured at the Siemens VAI factory in Shanghai, China, which has at its disposal the world’s largest sleeve grinder for tapered neck bearings. During the last decade more circumferentially welded bushings were produced at this site than at any other Morgan location.

As part of the production process, the customer visited and audited the Shanghai factory, observing in detail all the critical processes and procedures that would be used for the special bearings for the new mill stand. The sleeve-grinding process and circumferential Babbitt welding process were of particular interest. The customer was so impressed that the final agreement designated the Shanghai facility as the sole supplier for the sleeves and bushings.

Production ramp-up ahead of schedule

By July 2009, all bearing parts were on-site in Oita and ready for commissioning, which started the following month. Since then, the new mill stand has increased production capacity smoothly and well ahead of schedule. ■



Application of proprietary circumferential Babbitt welding technology

Authors

Thomas C. Wojtkowski Jr., Gabriel F. Royo

Contact

morgoil.metals@siemens.com

In-house manufacture of the Mulpic plate-cooling system in China

Closer to the Major Markets

The Taicang factory was established in 2004 to produce and assemble high-quality equipment for aluminum mills, bar mills, billet casters, cooling beds, gear reducers, mill guides and tube mills. The factory set new standards for foil-mill manufacture and assembly in terms of high-tech product performance, high-quality manufacturing and cost efficiency. Through the utilization of local, in-house manufacturing resources, competitive pricing combined with strict quality-control supervision is assured. In 2008 and with business growing, Siemens VAI added new facilities with 3,100 m² of additional floor space, pushing the total floor space to 4,500 m². The new building has an extensive area dedicated to precision assembly of items like rolling-mill stands and features two 50-ton overhead cranes and a modern office space over five stories.

Siemens VAI has received some 20 Mulpic orders for installation in plate mills throughout Europe and Asia.

First Mulpic equipment assembled at Taicang

The customers of modern plate mills are demanding products with higher strengths, increased toughness and better weldability. And nowadays customers expect many of these products, such as high-strength line pipe, to be produced using on-line cooling in addition to microalloying and thermomechanical rolling practices. Mulpic technology is capable of meeting these demands by providing both accelerated cooling (AC) and direct-quench (DQ) cooling of plates over a wide thickness range in a single online system.

A golden rule in a global economy calls for locating production value chains close to major markets whenever possible. Consequently, Siemens VAI now manufactures and assembles Mulpic plate-cooling equipment in-house in China. In the Siemens VAI China factory, situated in Taicang, around 40 km to the west of Shanghai, equipment for the iron and steel industry is manufactured for both the Chinese market and for worldwide use in Siemens VAI products.



Mulpic installation in 4.1 m plate mill of Wuyang Iron and Steel Co. Ltd., China

Mulpic plate-cooling equipment is now being assembled at the Siemens VAI factory in Taicang. Siemens VAI in the UK holds the exclusive license for Mulpic, which is split into individual component packages for separate sourcing. The components are then assembled in Taicang under strictest quality-control supervision. Exhaustive testing in the Taicang work-

Siemens VAI has received some 20 Mulpic orders for installation in plate mills throughout Europe and Asia



Mulpic entry-zone separation sprays



Assembly of the Mulpic system in the Taicang workshop

shop prior to delivery assures full functionality and reliability of all equipment and systems. The result is an excellent finished product. The first Mulpic order to be assembled in the Taicang plant was for a Japanese plate producer, with start-up in July 2010.

Growth driver for the Siemens VAI portfolio

Whereas operating costs and specific production quality, safety and environmental requirements influence plant-engineering purchasing decisions in the traditional steel markets, in the new markets like China and India Siemens VAI has to focus on meeting the local requirements with standard solutions. This requires proximity to the customer.

“We will only be successful if we are perceived as a local enterprise,” explains Tim Dawidowsky, previously responsible for Siemens’ mining and steel business in China. High-tech manufacturers in Europe, the United States and Japan are continuing to focus on efficiency and flexibility of their produc-

tion processes. In China and India, however, the emphasis is on producing steel with simpler and cheaper plants to develop infrastructure. “Siemens VAI is going to develop plants specifically for this segment of the market and launch them onto the world market from China and India,” Dawidowsky says.

Within the scope of the worldwide competence and production matrix, Siemens VAI China will also be given the responsibility for the development and design, engineering, production, project handling, commissioning and service of new developments in the field of rolling. ■

Author
Gary Garfitt
Contact
platemill.metals@siemens.com



Technology packages for quality improvements in hot-strip mills

Hot-Strip Quality – Any Time, Any Place

The hot-strip mill is the main supplier of hot band in many steel plants. Mill availability and quality are therefore crucial, since every unplanned shutdown also affects upstream and downstream production. Optimal presetting and control is needed to minimize scale, out-of-tolerance production, crop losses and overwidth losses. Efforts of Siemens VAI to develop and supply the best equipment for new hot-strip mills have led to many improvements and inventions. Siemens VAI has also developed technology packages dedicated to the modernization of existing mills to keep these plants up to date and competitive.

Managers of hot-rolling mills face an increasing demand for high-quality products. This trend will remain at a high level and will grow even further. Among the quality features sought are geometric properties such as uniformity and repeatability of width, thickness and flatness. Surface properties are equally important, since damage to the hot-rolled strip is permanent. Recent improvements in quality and productivity have been strongly driven by developments in automation. Automation excels when high targets of dimensional tolerance, microstructure and surface quality must be met. The Siroll HM modernization packages for hot-strip mills are aligned to improve product quality, extend the product mix, reduce conversion costs, increase throughput, ensure safety and protect the environment. This article focuses on short descriptions of selected packages targeting improvements in strip quality (Figure 1).

The components and line concepts for hot-rolling mills are optimized in terms of delivery time, functionality and complexity. The technology packages comprise know-how and expertise in process technology, layout competence, mechanical equipment,

electronics, hydraulics, drives and automation systems as well as turnkey competence from in-house resources of Siemens VAI. The essential requirement – to keep downtimes and disturbances of production for the installation of new equipment as low as possible – can be achieved with offline assembly and component pre-testing in the workshops. Where suitable, integration tests in the workshop or on site before the equipment is used for production are performed to ensure optimum functionality.

Descaling

In terms of product quality, surface requirements can be met with a more effective descaling process. Siemens VAI descalers are designed for low heat losses, and minimum water and energy consumption. The descaling solutions are characterized by the use of variable-speed pumps with high flow rates powered by inverter-driven AC motors and the application of an optimized nozzle pattern. The benefits of this descaling package are reduced investment costs and lower maintenance costs as well as substantial energy savings due to flexible operation according to process requirements.

>>

Fig. 1: Overview and classification of modernization packages

	Targets to be achieved										
	Quality improvement			Reduction in operating costs			Product-mix extension		Safety, green solution		
	Thickness/width	Profile/flatness	Surface	Productivity/yield	Maintenance	Personnel	New dimensions	New steel grades	Safety	Environmental protection	Energy savings
Advanced mill pacing and management of reheating system				✓		✓				✓	✓
Descaling			✓	✓	✓						✓
Edger-width package	✓			✓							
Encopanel				✓			✓	✓			✓
Coilbox	✓						✓	✓			✓
Crop-shear solutions				✓	✓		✓	✓			✓
Work-roll lubrication			✓	✓			✓	✓		✓	✓
Hydraulic automatic gauge control (HGC) package	✓			✓			✓	✓			
Profile and flatness package (incl. SmartCrown)		✓		✓			✓	✓			
Advanced work-roll cooling		✓	✓	✓							✓
Morgoil bearings	✓				✓	✓	✓	✓			
Microstructure target cooling				✓				✓			
Upgrade cooling system				✓	✓			✓			
Microstructure monitor						✓		✓		✓	✓
Downcoiler package (Power Coiler)				✓			✓	✓			
Pinch-roll polisher			✓	✓		✓			✓		
Surface-inspection package			✓	✓							
Sample-taking station						✓			✓		
Safety packages									✓		

>> Edger-width package

The final strip quality can also be affected by deviations in slabs and transfer bars: deviations in slab temperature or slab width lead to significant deviations in the final strip width and decreased geometrical strip quality.

In addition to the heavy edger solution with highly effective and reliable width reductions that decrease the number of slab formats and thus improve quality, the Siemens VAI edger-width package offers compensation for wedge-shaped slabs and temperature deviations. The fully hydraulic vertical edger lets roll-gap adjustments be made during rolling. Advanced automatic width-control functions (AWC) enable the compensation for width and temperature deviations whereby the short stroke compensation (SSC) reduces narrow head and fishtail effects. Highest accuracy is offered through the absolute width measurement, which can be extended to the Siroll camber gauge to provide real online camber measurement at high accuracy, linearity and reliability with two stereoscopic cameras. The possible steering and cobble reduction resulting from this package lead to reduced losses and damages and improved width quality.

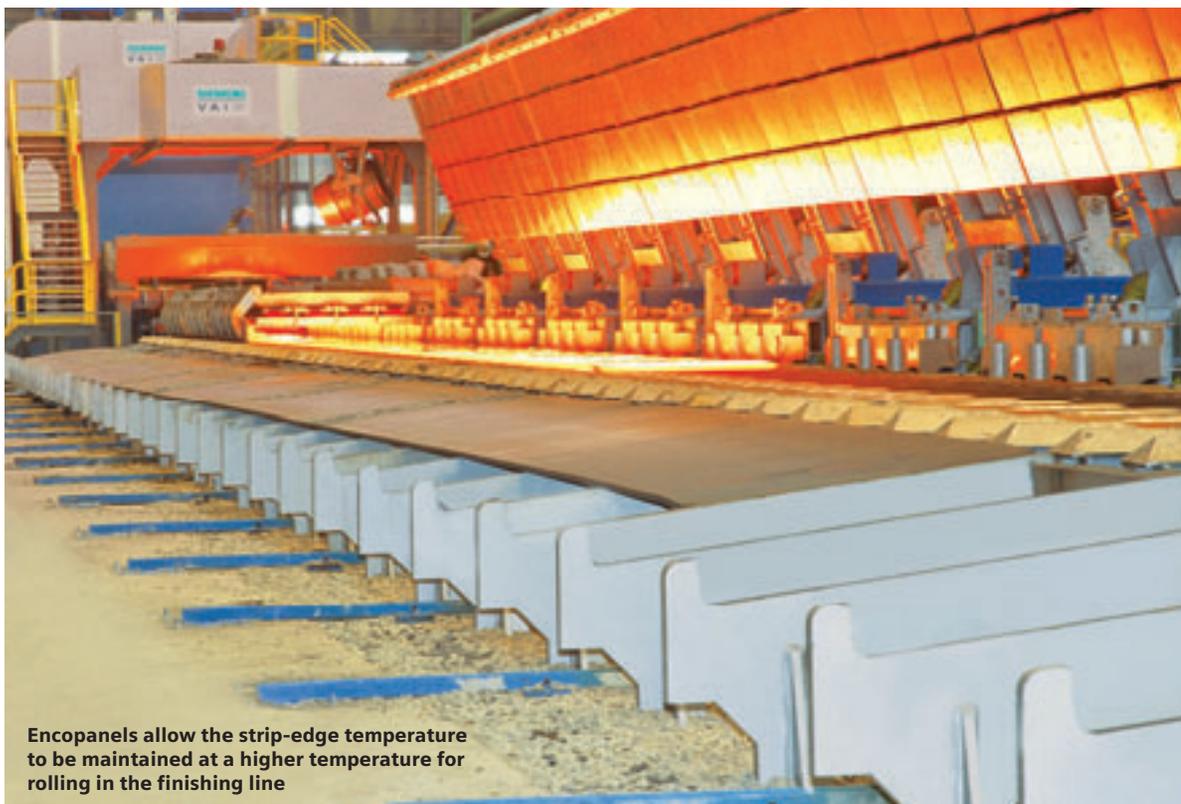
Encopanel

The Encopanel heat-retention system is installed after the roughing mill and conserves the heat of the

transfer bars and enables a more accurate control of the strip temperature. This is achieved by automatic selective raising or lowering of the heat-retention panels. The solution allows also the strip-edge temperatures to be maintained at a higher temperature for rolling in the finishing mill, thereby avoiding edge cracking. As a special feature, bottom-scale clearing panels are mounted on specially designed carry-over bars, which oscillate to ensure that scale is discharged from the system to provide a scale-free Encopanel face to the transfer bar, which assures a high-quality strip.

Coil box

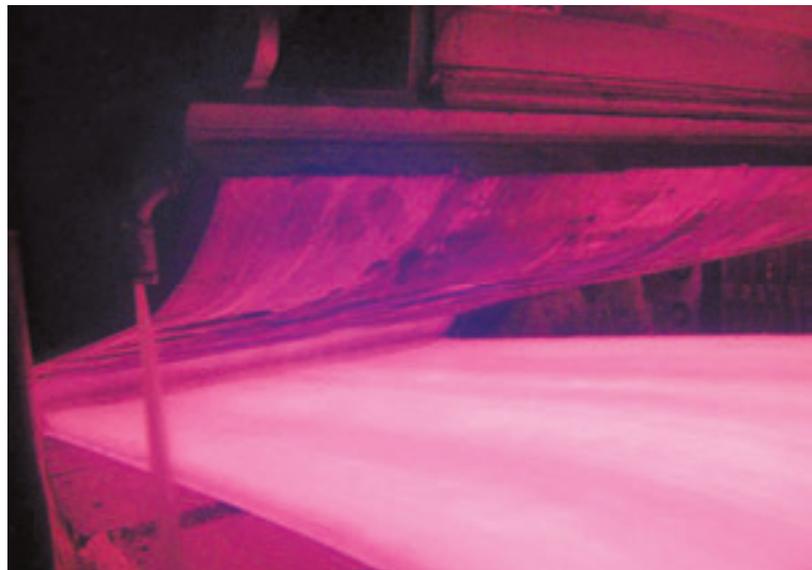
As an alternative to Encopanel, the coil box coils the roughed strip after the last roughing mill pass. The roughed strip is then moved to the uncoiling station and uncoiled for rolling in the finishing mill at the speed required to feed the finishing mill. With the use of a coil box, thinner and longer roughed strips can be created. This improves the load of the finishing mill and therefore the quality of thin-gauge rolling. The thermal losses of the remaining strip compared to uncoiled strips are reduced. Typically no or only very small temperature speed-ups are required, leading to less speed variations in the mill and better cooling control after the finishing mill. Better thermal homogeneity leads to better thickness performance and better surface quality, since tem-



Encopanel allows the strip-edge temperature to be maintained at a higher temperature for rolling in the finishing line



Finishing mill equipped with various technological packages



Application of work-roll lubrication contributes to improved strip quality

perature differences equalize due to strip contact with other strip parts.

The Siemens VAI coil box is characterized by modern design features such as coil transfer without the use of a mandrel, a heat shield, simultaneous coiling and uncoiling operation, a pinch-roll leveler unit and special measures to keep high surface quality, especially for stainless steel. Advantages of this equipment include reduced power rating and lower energy consumption in the mill train as well as shorter line length.

Work-roll lubrication

By installing good barrel lubrication for work rolls, surface defects are avoided and roll wear and roll force are reduced. The advantage of this Siroll HM solution is the effective application of lubrication media onto the work rolls, avoiding scale build-up and peeling of the work-roll surface. A minimum of rolling oil is consumed because the oil is applied precisely at selected times and controlled exactly to ensure stable rolling. A lower coefficient of friction between the work rolls and the strip leads to a significant reduction of the rolling force and improvement of the work-roll surface quality, and thus to better strip quality (see metals&mining 03|2009).

Hydraulic gauge control (HGC)

The main motivation for installing an HGC package is better mill performance as limitations in roll force and insufficient speed response times are extended. The impact on strip quality is realized through the improved gauge tolerances achieved with the hydraulic

gauge control compared to older HGCs or electro-mechanical screw-down systems.

Siemens VAI offers three types of HGC packages for new mills and for modernizations: long-stroke design, short-stroke design, and servovalves located close to hydraulic cylinders on top of the mill stands. For modernizations, the electro-mechanic or older hydraulic screw down is replaced and sophisticated, non-linear hydraulic gauge control is applied. This step is taken to ensure improved thickness tolerances for every cylinder layout and to set the basis for uniform thickness of the strip.

Profile and flatness package, including SmartCrown

Profile and flatness are geometrical quality parameters affected by closer and closer tolerances and requirements. With the variable work-roll bending and shifting system SmartCrown a worldwide established and installed technology is available to control profile and flatness. Due to SmartCrown's large adjustment capability, only one grind can replace all roll grinds of conventional rolls, which are usually employed in a mill stand in order to comply with the profile and roll-shape requirements of various rolling programs. Complemented with flexible and economical bending solutions such as the L-shape bending block, the actuator capabilities for modern mills can be implemented with less effort compared to other solutions. In addition, the profile and flatness package includes sophisticated models that apply fast online optimization algorithms and detailed calculations of roll and strip shape. This permits the >>

>> suppression of many types of buckles including higher-order strip defects such as quarter buckles (see *metals&mining* 03|2009).

Advanced work-roll cooling

Due to bending or virtual crown limitations, certain roll-gap profiles cannot be achieved. The Siemens VAI advanced work-roll cooling system features not only an increased cooling power but also dynamic work-roll cooling with cooling flows that can be adjusted in a certain range over the width. The system applies a dynamic flow in headers equipped with different nozzle patterns: basic, negative or positive roll cooling. Basic roll cooling ensures that the roll is sufficiently cooled to meet the rolling conditions of the plant. Positive roll cooling applies more water to the edges of the roll. Negative roll cooling applies more water to the center and reduces the thermal effects on the inner part of the roll. When all these systems are brought together, highly flexible control can be achieved. Working alongside the roll bending and shifting system, strip profile and flatness control have another actuator for influencing the roll shape and this cooling system also avoids surface defects and reduces roll wear.

The improvement of strip quality is achieved by enhanced shape control, which results from the adjustment of specific flow rates along the roll barrel by proper combination of headers, the control of thermal expansion of work roll, and a wider control range of the profile of loaded roll gap and strip. Further improvements of rolls and strip-surface quality are achieved by reduced peeling and banding, which means fewer strip-surface defects. Scale breaking away from the strip is washed away and prevented from being rolled in.

Strip-cooling package

A very important aspect for strip quality is the selection of an appropriate cooling technology. Advanced cooling solutions from Siemens VAI for the hot-strip mill include highly efficient equipment components, cooling control, and models for optimum cooling results for all kinds of steel grades including solutions for modern multiphase grades. Nearly all needs for cooling rates and budgets can be fulfilled with power cooling headers for high cooling rates; laminar turbo headers with high water flow and normal laminar headers, both available with variable flow control or switch valves; and quick switch headers for ultrafast switching times. This is important for the revamp and upgrade of existing plants, and for new steel grades facing space limitations that need to be resolved.

Siemens VAI developed a new cooling-section control system using the Gibbs' free enthalpy to calculate

the steel transformation very precisely on the basis of a thermodynamic model. New developments in the physical modeling of steel transformation make it possible to compute temperature and phase fractions along the entire cooling section – in real time. By means of a model-predictive control function, the stipulated time curve of cooling in the cooling section is optimally adhered to for the whole strip within the limits of the plant. This enables Siemens VAI to offer a cooling section that works right on the steel producer's targets – the microstructure properties of the strip (see *metals&mining* 03|2009).

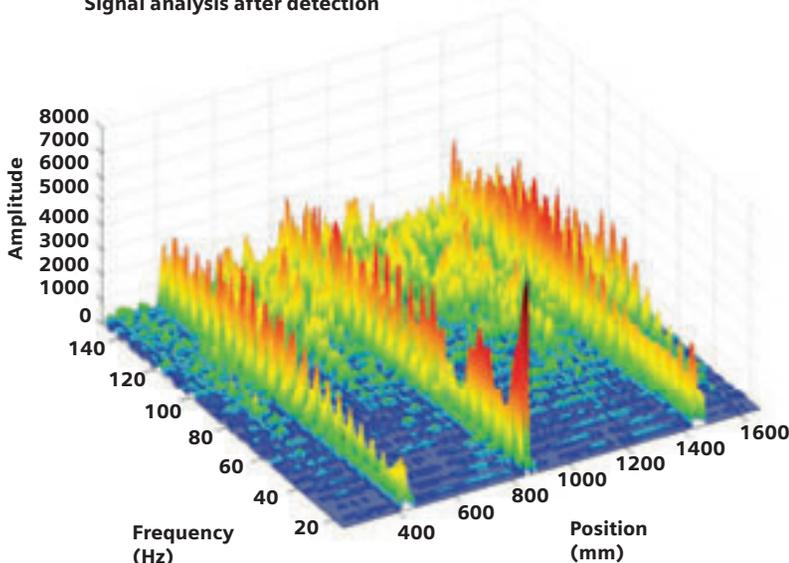
Pinch-roll polisher

Material deposited on the surface of pinch rolls during strip coiling on the down coiler negatively affects the strip surface and must be removed periodically by means of grinding. The automatic pinch-roll polisher was developed to detect, locate and remove the surface deposits for the upper and lower pinch roll and to improve strip-surface quality.

The innovative technology is based on a grinding system that traverses the rotating pinch roll and automatically recognizes material deposits. By means of oscillating movements, the unit grinds this deposit only where it occurs and until it has been completely



Signal analysis after detection



Signal analysis after grinding

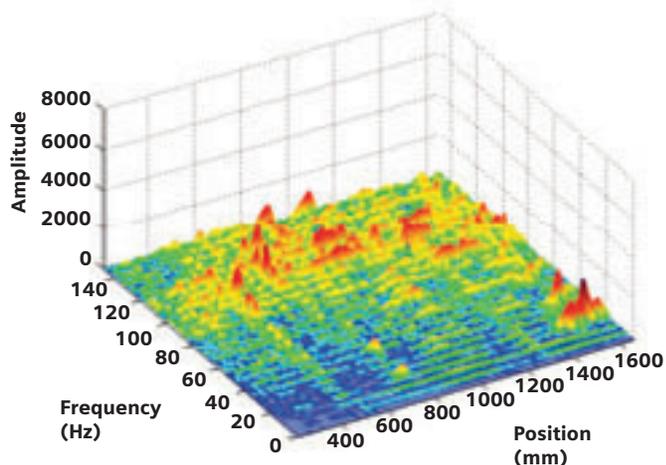


Fig. 2 and 3: Demonstration of roll-surface improvement

removed (Figures 2 and 3). The system also automatically inspects the surface profile and wear condition of the pinch roll in order to determine the optimum time for a roll change.

A grinding head equipped with vibration sensors detects and removes stickers on the pinch-roll surface. Areas with deposits generate an increased

vibration level, causing the grinding head to shift accordingly and remove contaminants. The average duration of a total cycle is only 100 seconds, which means a pinch-roll polishing procedure can be done during regular operation; no specific shutdowns or rolling interruptions of the hot-strip mill are necessary.

SIAS – surface inspection package

Surface defects are rarely detected directly after the rolling process but often later during inspection or even some days later during pickling. As the requirements for strip quality are very high, there is a serious risk of material loss due to surface defects in many coils.

With the SIAS surface inspection system, Siemens VAI developed strip-scan technology with a line camera configuration and a sophisticated light system for optimum picture quality, which is the starting point for good detection and classification of surface defects. Real-time image display enables 100% length inspection to be realized. The system features a polymorphic detection algorithm and a Coulomb HyperSphere classifier. Best non-defect performance can be assured with near-zero civil-work installation on the hot-strip mill.

With these examples as well as other technology packages and solutions for hot-strip mills, Siemens VAI provides solutions for a fast return on investment that keep mills at peak performance. ■



Author
Berta Haring
Contact
hotstripmill.metals@siemens.com

Production of
perfectly flat strip

COLD ROLLING >



Cold-rolling technology packages for quality improvements

Potential for Continuous Improvement

Meeting today's quality requirements means producing perfectly flat strip on a consistent basis, which demands highly sophisticated actuators, measurement and control systems. This article details ways to keep existing cold-rolling lines on the forefront of technology.

To satisfy the market's ever-growing quality requirements, manufacturers need to meet quality demands with the highest cost efficiency. Operators of existing cold-rolling mills have a range of options available to optimize their plants.

Upgrade to continuous operation

Continuous operation ensures tightly stabilized process conditions and high process efficiency for a

wide range of cold-mill products so that stringent product-quality specifications can be met. Continuously operating cold mills provide the capability for output optimization. Reduced strip-head and tail-end losses also contribute to better overall yield.

Upgrades to continuous operation are typically carried out on batch-type tandem cold mills or continuous pickling lines with tandem cold mills to produce a CTCM or a PLTCM, respectively.

		Motivation for modernization measures									
		Reduction of operating costs			Quality improvement			Product-mix extension		Environment Safety	
		Productivity yield	Maintenance	Personnel	Thickness	Flatness	Surface	New dimensions	New steel grades	Safety	Environmental protection
Cold-rolling packages for quality improvements											
Modernization packages	Upgrade to continuous operation	X		X			X			X	
	Pickling-section optimization	X	X			X	X		X	X	
	Flatness-quality package				X	X					
	Drive-train package	X	X		X			X	X		
	Strip-cleanliness quality package						X			X	
	Roll eccentricity compensation (REC)	X			X						
	Automatic gauge control (AGC) and thickness control package	X			X	X					
	SIROLL Off-gauge optimizer	X			X						
	Speed optimization system (SOS)	X			X	X	X				
	Dynamic rolling program (DRP)	X			X			X	X		
	Equipment Performance Analyzer	X			X	X	X				

The upgrade to a PLTCM eliminates threading and unthreading operations and enables substantial capacity increases (see Figure 2). Quality and yield improvements and operational savings over batch operations are further benefits. The linkage with a pickling line eliminates intermediate coil handling and storage provisions, both of which compromise quality and yield. The resulting just-in-time processing from hot coil to pickled and cold-rolled coil provides further cost savings (see Figure 2).

Pickling-section optimization

Carbon steel strip has to be pickled perfectly before being cold rolled or sold. New, increasingly complex regulations also raise the bar in terms of safety and environmental protection. A package from Siemens VAI for the pickling process section comprises the complete chemical treatment up to the strip dryer with all ancillary infrastructure systems.

A unique feature of this package is the Siroll Faplac (Fully Automatic Pickle Liquor Analysis and Control)

system with a rinse and pickling process model that ensures efficient operation by controlling acid and iron concentration (waste acid). Additional roll and strip-temperature models ensure that tight process-temperature tolerances are met. These models help avoid overheating, prolong operating life, and lower the consumption of pickling liquor while guaranteeing high pickling-surface quality (see metals&mining 1/2009).

The additional automatic Siroll SIAS surface inspection system at the end of the line provides data feedback for pickling-line process control, checks product quality, and detects pickling failures or strip marks.

A new generation of Siemens VAI scale breakers helps to improve surface quality. The scale breakers feature a compact design, short line shutdown for installation and cold commissioning, quick on-the-fly cassette exchange, low energy consumption and low maintenance costs. A highly efficient scale-exhaust system using wet or dry system processes cuts dust >>

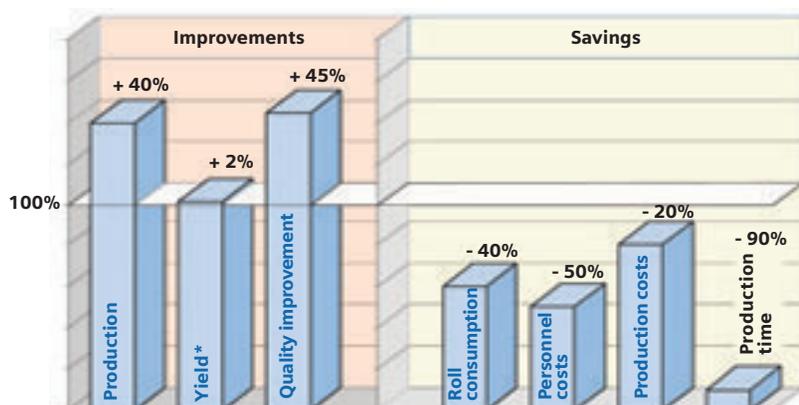


Fig. 2: The conversion of an existing pickling line and an existing batch mill to a PLTCM offers substantial savings and improvements

100% represents separate units for pickling and cold rolling

* related to hot strip



Continuous tandem cold mill at voestalpine Stahl, Linz, Austria

>> emissions. Special backup rolls with integrated forced ventilation protect bearings from dust, thus increasing bending roll operating life.

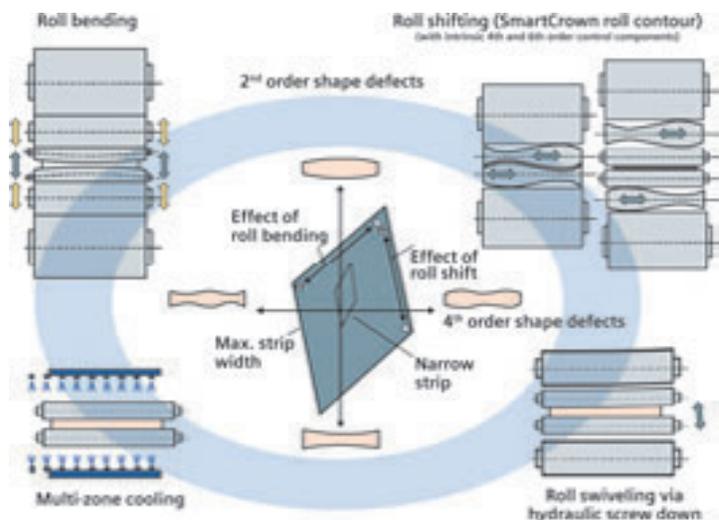
An anticross bow unit behind the leveling units can help to improve strip flatness. The drive system for the bridle rolls – necessary to achieve high strip tension – is available as a complete electrical solution

with separate drives for each roll, or as a combined electro-mechanical solution with one main drive and one overlap drive plus planetary gears.

Mill-stand upgrades for superior strip flatness

In the future, many cold mills will process high-strength and advanced high-strength steels (HSS/AHSS).

Fig. 3: Siroll SmartCrown allows drastic reductions in the number of required product-dependent roll crowns.





Uniform finished surface quality at the pickling line of Dunafer, Hungary

This means new challenges for flatness control systems, since these grades require thickness accuracies of a few micrometers and are more susceptible to shape corrections in the mill.

The Siroll CM flatness-quality package offers solutions to add, replace or enhance shape-control systems in any kind of cold-rolling mill. Beside thickness accuracy of a few micrometers, the package includes all relevant flatness actuators, the flatness measurement systems and the flatness control system itself.

Flatness measurements can be provided either by the Siemens VAI Planicim shapemeter roll system or by the non-contact Siemens VAI Siflat (see *metals & mining* 1/2010) measurement system. Siflat is designed for use in reversing and non-reversing cold mills for steel and nonferrous materials and features high flatness measuring accuracy independent of rolling speed. Additional characteristics include edge detection and strip-width measurement. The system boasts a long service life and low maintenance costs.

The backbone of the Siroll CM system is the Siroll SmartCrown (see *metals&mining* 1/2010) roll contour, which can be applied to the work and intermediate rolls. Due to its design, SmartCrown provides second-order plus fourth- and sixth-order roll-contour components. Today roll-shifting technology is used not only as a quasi-static presetting device to control roll stack deformation but also dynamically to enhance the working range of associated roll-bending systems. This feature allows a drastic reduction in the number of different product-dependent roll crowns. Such a rolling mill can even handle complex

product mixes with only one roll contour used on all mill stands (Figure 3).

On top of roll shifting and bending, multi-zone cooling in the last mill stand is another powerful actuator for shape-defect residuals of all orders.

The Siroll CM flatness control system features self-learning parameter optimization, enabling an adaptation to rolling conditions and material properties. Also included are variable (selective) gain controllers for a case-dependent control reaction, an optimization of the dynamic bending adjustment range and a disturbance variable feed forward for dynamic set-up tracking. This helps to accommodate changes of crown and wedge on the incoming strip as well as in the thermal buff of the rolls. Beside its closed-loop control functionality, the control system serves to track incoming shape disturbances and to adjust the dynamic set-up in downstream stands. Particularly useful when rolling HSS and AHSS grades, this feature provides a highly stable shape-related set-up for all kinds of operational conditions.

Drive-train upgrade

In terms of final strip quality, the performance of a multi-stand mill largely depends on its main drives. The reduction capability of the mill stand, especially for hard grades, is influenced by the drive-train system (motor, gears, spindels) and the work-roll diameters. An upgrade of the mill-stand drive train will provide a production capacity increase if the mill stands are the major bottleneck for most of the production.

>>

>> A bottleneck study should therefore be performed before committing to an upgrade. In this study, which Siemens VAI can perform on request, the actual plant operation is calculated with a pass schedule and throughput calculation program to produce an analysis of improvement variants.

Strip-cleanliness measures

Remaining liquids on the strip impair surface quality during recoiling. A strip blow-off system with a special air-nozzle arrangement can be installed to remove any residual emulsion. The nozzles act on the strip surface in a cascaded manner and directly form the interfaces between work roll and strip, work roll and backup roll, and between the intermediate and backup roll in 6-high stands. The liquid removed by the air blast is captured in an exhaust system. The cleaning system guarantees efficient blow-off at all mill speeds, ensuring highest strip-surface quality after rolling.

Roll eccentricity compensation

Mill rolls create oscillations due to thermal asymmetry, grinding inaccuracy, and asymmetrical adjustment of the Morgoil bearings via drive keys. Roll-eccentricity frequency compensation is required to eliminate any resulting strip thickness variations. Siemens VAI has developed a new roll eccentricity compensation (REC) system that evaluates eccentricity based on strip thickness, roll force and strip-tension variations (Figure 4). The system analyses the incoming signals, extracts frequencies harmonics from the rolls and calculates the required compensation signals for all frequencies in real time. These signals are then transformed into a position-correction signal for the roll-gap control. The system requires no learning sequence.

Automatic gauge control

Tight strip-thickness tolerances like those required by the automotive industry call for the use of advanced automatic gauge control (AGC) systems. The Siemens VAI AGC package combines hydraulic capsules, servo-valves, transducers and a control system to create a comprehensive solution. Using a new advanced mass flow concept AMF^{new}, the system ensures a thickness precision to a few thousandth of a millimeter and is capable of quickly reaching the target thickness after a dynamic rolling program change in spite of imprecise setups. All roll-force cylinders are manufactured in-house.

Off-gauge optimization

Off-gauge strip between production runs causes excess processing costs and lowers facility yield. Leveraging the mill's hidden potential, the Siroll Off-Gauge Optimizer package significantly cuts reprocessing costs. The package combines technology, process control and instrumentation, and features the smart implementation of the tandem cold mill control algorithm based on the mass-flow principle.

In a reference installation at the voestalpine Stahl continuous tandem cold mill (CTCM) in Linz, Austria, the package proved its efficiency by shortening off-gauge lengths by an average of approximately 8 m (the total mean off-gauge length has been decreased from 13.72 m to 5.79 m). This corresponds to a yield increase of 0.25% for a typical product mix, or to an output gain of approximately 4,000 tons per year for an annual production of 1.6 million tons. The investment in the package typically pays for itself in twelve months.

Equipment Performance Analyzer

The Equipment Performance Analyzer management strategy aims at enabling non-stop, top-speed and zero-

Fig. 4: The Siemens VAI Roll Eccentricity Compensation system calculates roll eccentricity compensation signals for all frequencies in real time

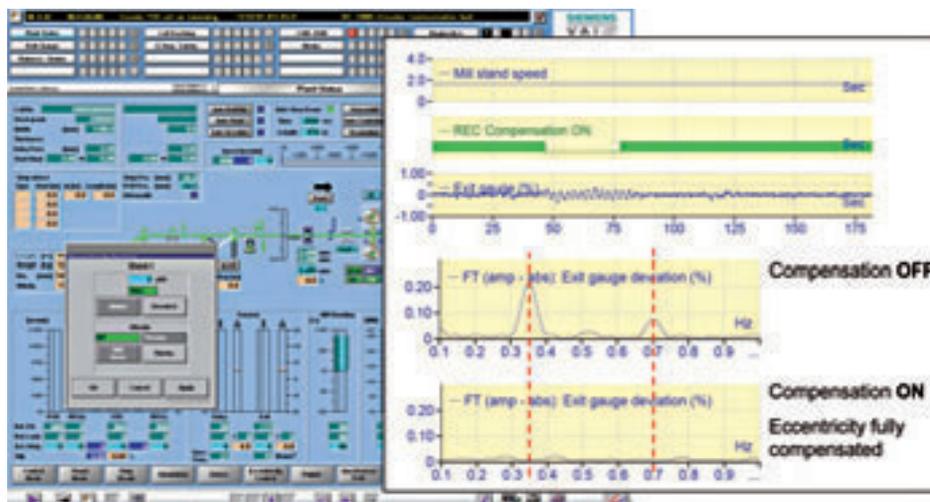




Fig. 5: The Equipment Performance Analyzer module shows comparisons of present to past performance in concise HMI reports

defect production by detecting all losses. Instead of just monitoring mill output, the Equipment Performance Analyzer package from Siemens VAI compares actual with potential production, helping to identify any shortcomings. Since most of the required data are already available in the process automation system, the package can be added fairly easily (see Figure 5).

The Equipment Performance Analyzer module not only displays production efficiency but also shows comparisons of present to past performance in concise HMI reports. Fully customizable and requiring only minimal manual input, the Equipment Performance Analyzer package ensures better personnel involvement as operators acquire deep process knowledge, follow indicators, identify stoppages and spread best practices across all teams. In a recent installation at the Tangshan PLTCM, users established a hall-of-fame section in the HMI system for the operating teams to compete against one another; the competition has led to fast production start-up and higher productivity.

Speed optimization system

The pickling and the tandem-mill sections of a PLTCM need to operate in close coordination to reach maximum throughput; the speed optimization system (SOS) package is the answer from Siemens VAI. The SOS package prevents stoppages in the pickling and tandem sections and ensures that the mill runs at a constant speed with as few changes as possible. The system uses data from basic automation (saddles occupancy, actual speeds and looper filling levels) plus

additional information from process automation such as maximum pickling speed or looper sizes. From this data, the system calculates optimum set points for all aggregates so that the entire line works at the highest throughput, operates smoothly and ensures maximum service life for all mechanical equipment.

Dynamic rolling strategies

Transitions within and between individual strips in continuous tandem mills need to be performed using specific methods to optimize production and minimize yield losses. Two transition types are prevalent: The first is a transition within a strip with an exit gauge change or load distribution optimization (e.g., to avoid equipment limits). The second type refers to transitions at a weld seam with or

without geometric or property changes.

The dynamic rolling program (DRP) from Siemens VAI offers specific control strategies for these transition types and ensures safety and qualified weld rolling. The implemented modes are flying-gauge change (normal mode for light and heavy changes), constant force rolling (for heavy changes), and open-gap rolling for special cases. The DRP package ensures a tight synchronization and task sharing between process automation (for example taking care of strategy selection, transition setups and wedge-length calculation) and basic automation (managing weld tracking, switching mode and the selected closed-loop controls). Automating these transition strategies helps to minimize strip-breaking risks and increases productivity by eliminating manual mill-floor operations.

Summary

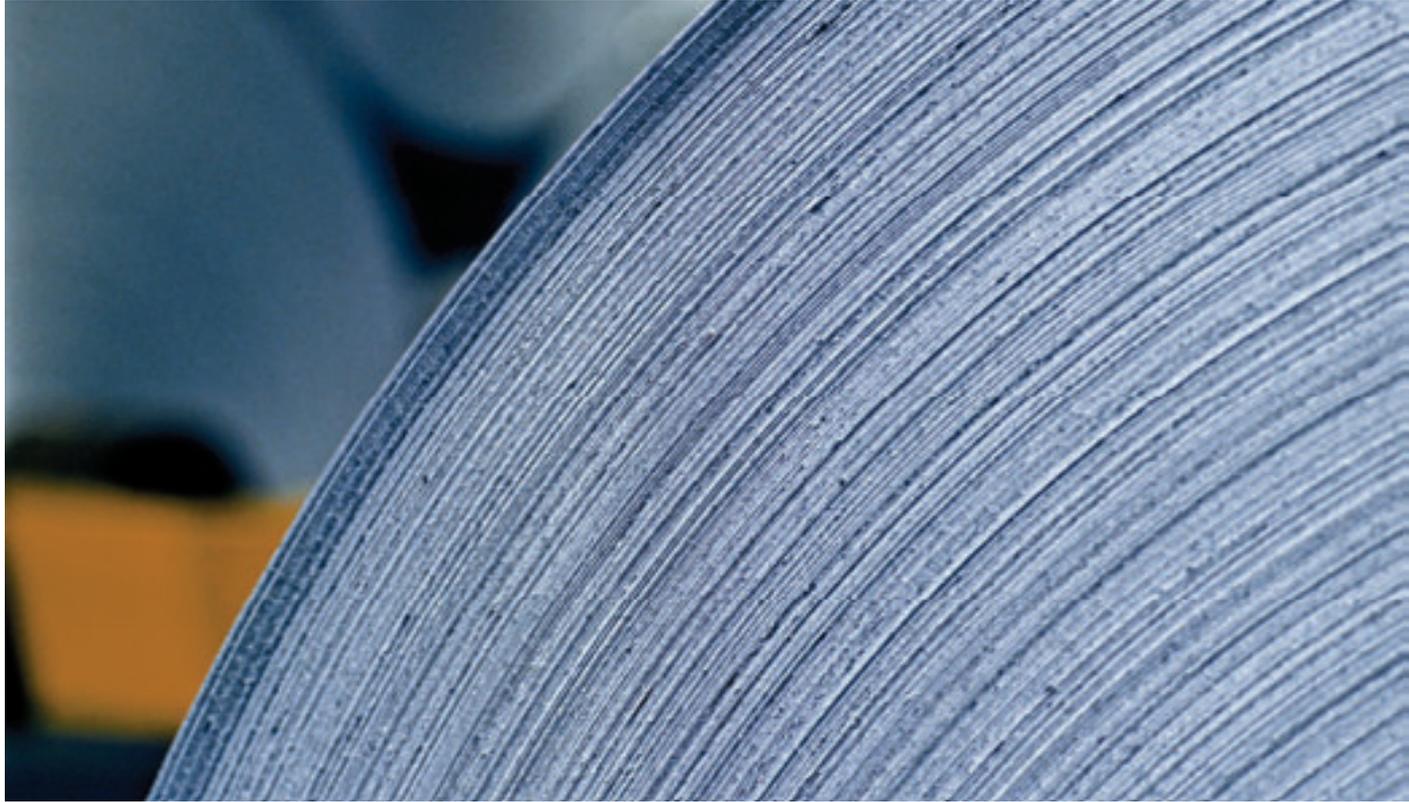
Staying at the forefront of rolling technology is a continuous process. Siemens VAI quality-improvement packages feature a smart plug-and-play architecture that is flexible enough to adapt to many environments and offers users a high degree of safety to meet project objectives and a quick return on capital investment. ■

Authors

Sabine Fabris, Stéphane Georges, Anna Stabauer

Contact

coldrollingmill.metals@siemens.com



Siroll Heavy Duty Shapemeter

Taking Reliability To the Next Level

Air-bearing technology has been used for decades in the metals industry. A recent addition to the Siemens VAI portfolio that depends on this technology is the Siroll Heavy Duty Shapemeter, which has been specifically designed for cold-rolling-mill applications.

The Siroll Heavy Duty Shapemeter from Siemens VAI provides a cost-effective online flatness measurement system for cold-rolling mills. Designed specifically for cold-mill applications and based on the market-leading Siroll Air Bearing Shapemeter Roll, the Siroll Heavy Duty Shapemeter's modular design enables it to be tailored to suit any specific application without compromising its full operating capability. The load-bearing capability is greater than any previous air-bearing roll and new features that improve performance have been incorporated.

Highest quality

Today's rolling-mill operators are faced with the challenges of producing the highest-quality material and maximizing productivity levels. Operators must also make efforts to increase equipment reliability, extend maintenance intervals, ensure optimum performance at all times and introduce cost-effective solutions. The Siroll Heavy Duty Shapemeter addresses many of these issues with its Automatic Trend Alignment (ATA) mechanism ensuring perfect alignment to the rolled strip at all times, optimizing performance and extending service intervals. Con-



Siroll Heavy Duty Shapemeter mounted on the ATA-enabled Retraction Mechanism

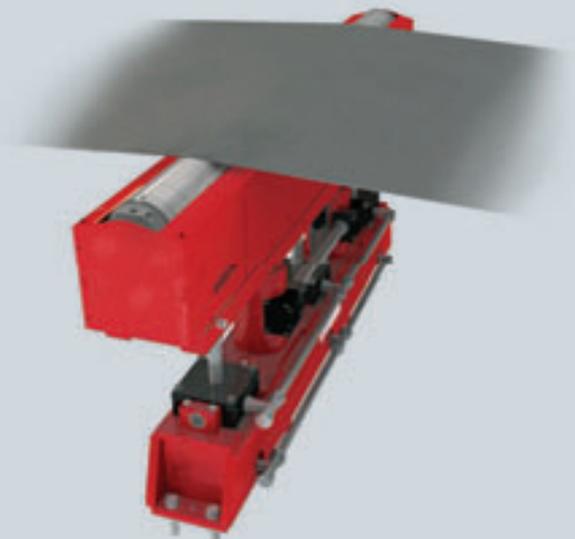
tinuous measurement, even at low mill speeds is a key feature of air-bearing technology, which offers significant performance advantages over alternative solutions. The modular design means that spare-part inventory may be kept to a minimum. The Siroll Heavy Duty Shapemeter easily accommodates the increasing strip widths of modern cold mills and is capable of measuring strip widths up to 3 m wide with thicknesses up to 5.5 mm. Increased resolution has also been achieved with the introduction of a multi-height retraction mechanism, which is available on all rolls and includes thrust sensing for optimum roll sensitivity.

An all-around performer

The Siroll Heavy Duty Shapemeter is suitable for a variety of materials including aluminum, carbon steel, brass and copper. With very low inertia and negligible friction, there is no need for a helper drive. As a result, the roll can be mounted closer to the roll bite, even between the mill housing posts. The air-bearing design has no electronics mounted in the roll; these are located remotely, in a conveniently accessible position. The roll's high sensitivity provides a continuous signal output, which is totally independent of line speed, while the simple design and modular construction offer easy on-site servicing. ■

Benefits

- Robust design specifically engineered for cold-rolling mills
- Self-aligning
- Retraction mechanism as standard
- Longer maintenance intervals
- Faster commissioning
- Modular design construction for reduced spare-part inventory
- Continuous measurement, even at low mill speeds
- Automatic Trend Alignment (ATA)
- No helper drive required
- Exceptionally low friction



The original Siroll Air Bearing Shapemeter Roll

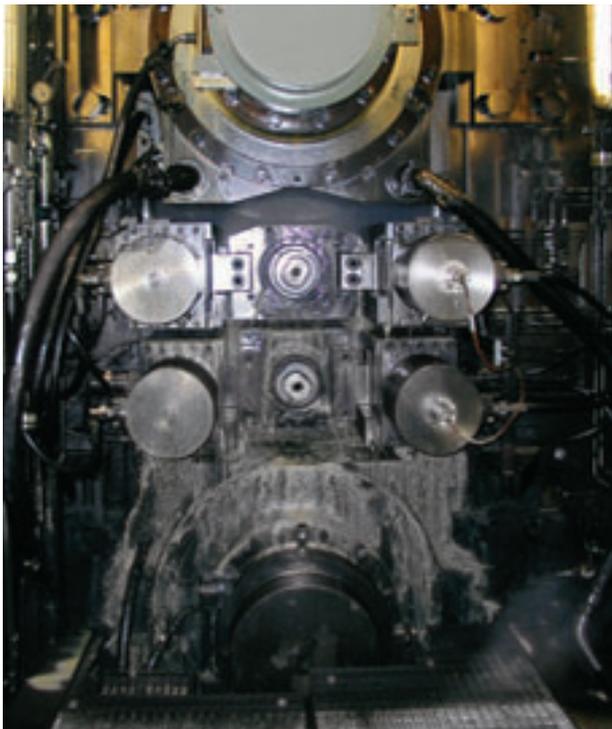
Author
Paul Bowcher
Contact
airbearing.metals@siemens.com

Quaker Chemical Corporation, voestalpine Stahl GmbH, Johannes Kepler University Linz and Siemens VAI join forces to develop improved coolants/lubricants

Combined Expertise For Better Rolling

With consideration to the ever-increasing production and application of high-strength steels in the industry and the development of new production processes, the need for highest-quality and customized coolants/lubricants is more important than ever. In early 2009, Quaker Chemical Corporation (Quaker), voestalpine Stahl GmbH, Johannes Kepler University Linz (JKU) and Siemens VAI therefore decided to pool their knowledge, experience and resources to develop better coolant/lubricant solutions for industrial applications.

ROLLING >



Producers will benefit from the cooperation between Quaker, voestalpine Stahl, JKU and Siemens VAI in the field of coolants/lubricants

The need for customized and specially developed coolants/lubricants in hot- and cold-rolling mills is steadily increasing due to ever-greater requirements placed on the rolling process and on value-added products. In particular, the rolling of high-strength steels poses enormous demands in both the rolling mill and the coolant/lubricant to be used. The applied medium must be optimized for all

foreseen rolling applications. Moreover, it must be ideally suited to meet the targeted quantity and quality requirements for various steel grades. "Optimized coolants/lubricants are prerequisites for ensuring smooth operations of the rolling mill," says Dr. Dieter Paesold, Cold Rolling Innovation Manager at voestalpine Stahl.

Powerful partners

A close cooperation between rolling-mill suppliers, coolant/lubricant manufacturers, rolling-mill operators and research institutes is therefore a vital prerequisite to develop oils and emulsions that meet all rolling requirements. A crucial factor here is the interdisciplinary understanding of the close physical and chemical interaction of coolants/lubricants, fluid-application techniques, media systems, mechanical components, and the electrical and control equipment used in a rolling mill.

"Optimized coolants/lubricants are prerequisites for ensuring smooth operations of the rolling mill."

Dr. Dieter Paesold, voestalpine Stahl

For these reasons, Quaker, voestalpine Stahl, JKU and Siemens VAI entered into an exclusive cooperation in early 2009 to develop better lubricant/coolant solutions for industrial applications. Siemens VAI brings into this cooperation its extensive experience and know-how related to the planning, engineering, erection and commissioning of rolling mills. Quaker,



Use of highest-quality coolants/lubricants in rolling is a decisive factor for smooth operation, top-quality products and longer equipment lifetime

headquartered in the United States, contributes with its vast knowledge about the chemistry, tribological* properties and manufacture of lubricants and specialty fluids used in the metals industries. voestalpine Stahl of Austria offers its operational know-how in the rolling and processing of hot strip, cold strip, galvanized strip and electrical steel plates. This cooperation is complemented by the involvement of the Institute of Computer-Aided Methods in Mechanical Engineering at JKU Linz, which contributes its expertise on the modeling of flat-rolling processes.

“With this exclusive cooperation, the partners have

set an ideal stage for further improving the productivity of hot- and cold-rolling mills through customized coolants/lubricants,” emphasizes Dr. Gerhard Finstermann, Head of Technology & Innovation at Siemens VAI.

“By pooling our forces and competencies, we can use our collective, comprehensive experience in rolling-mill technology and tribology to develop specific solutions that our market requires,” adds Peter Schellingerhout, Global R&D Manager for Rolling Oils at Quaker.

Fruits of a unique cooperation

Intensive research by the cooperation partners has increased the overall knowledge and understanding of the interrelated physical and chemical phenomena inside the roll bite, including their influence on frictional conditions. Further tribological improvements in the rolling process can be achieved through specific adjustments of various rolling and lubrication parameters. Furthermore, advanced models and tools are developed in an ongoing R&D project to predict rolling forces and rolling torques, taking into consideration tribological influence parameters (e.g., surface roughness, lubricant parameters).

The application of sophisticated simulation models combined with laboratory testing will lead to the development and optimization of coolants/lubricants specifically targeted to defined rolling tasks. Improved oils and lubricants can then be tested in the pilot rolling mill at the Siemens VAI workshop in Montbrison, France, as well in the cold-rolling mill of voestalpine Stahl in Linz, Austria.

For the benefit of producers

Potential beneficiaries for improved coolants/lubricants include all operators of rolling mills in addition to numerous downstream manufacturers of steel products, such as the automotive industry. Producers benefit from competent advice and tailored services offered by this unique cooperation between three highly experienced, well-known companies in the steel industry. The application of customized oils and emulsions in the rolling process results in higher mill productivity, an extended product range, improved surface quality of the steel strip and lower energy costs required for rolling. ■

Authors

Quaker Chemical Corporation: Peter Schellingerhout
 voestalpine Stahl GmbH: Dr. Dieter Paesold
 Johannes Kepler University Linz: Prof. Dr. Klaus Zeman
 Siemens VAI: Dr. Konrad Krimpelstätter

Contact

coldrollingmill.metals@siemens.com

*Tribology is the science and engineering of interacting surfaces in relative motion. It includes the study and application of the principles of friction, lubrication and wear.

Shears



Screw down



Successful spare-parts management with A-Class components

Working In Unison

Hot- and cold-strip rolling and processing lines are subject to considerable and constantly changing mechanical and thermal stresses. Regular maintenance of critical components is essential to ensure consistently high quality on the lines as well as smooth operation. Siemens VAI offers on-site system maintenance including repairs and preventative maintenance, spare-parts management and manufacture, and, for those parts that are subject to greater wear, repair and replacement in our own workshops.

Production facilities have undergone enormous developments in recent years – they are compact, more complex and offer higher productivity. And they boast significantly increased system availability, despite the fact that many plant components are more sensitive to the effects of wear. The task of service and maintenance departments is to ensure high technical availability, which means promptly replacing certain system components. By introducing a preventive maintenance concept, it is possible to replace these components at the right time and therefore avoid unplanned downtime.

In addition to defined servicing tasks, a preventative maintenance concept also ensures a reliable supply of spare parts. A particularly cost-efficient advantage is that arrangements are made directly with the plant supplier for repairs, spare parts and guaranteed delivery dates for critical parts.

Siemens VAI France is to date one of the few manufacturing companies to offer specialized high-tech equipment for the metals industries. The workshop in Montbrison, France, is well equipped with a range of advanced machines. In big jobs for ArcelorMittal plants, the Montbrison workshop is in charge of the critical components such as shifting and bending blocks, hydraulic-gauge cylinders and downcoilers (A-class components). Furthermore, preassembly



One complete spare

Customers are also invited to visit the Siemens VAI workshop.

One complete spare in refurbishment



of critical parts such as complete mill stands and cold band (carbon and stainless steel lines) are carried out in Montbrison, which means better quality and higher reliability.

A-Class components – the Achilles’ heel of production

Original A-class components are always designed and provided by the OEM (original equipment manufacturer) and are core components in the direct link with process tasks. A-class components are vital for hot- and cold-strip rolling and processing lines for flat carbon steel, stainless steel and aluminum. Spindles, mandrels, screw-down systems, capsules, hydraulic blocks, chocks and shears are just some A-class components.

Knowledge of A-class components and related processes enables Siemens VAI France to suggest and anticipate the various types of maintenance and necessary actions in order to avoid disturbances and quality degradation. Comprehensive feedback from our customers enables us to improve our solutions.

A formula to manage A-Class components

1+1+1 stands for the safest way to manage A-class components, namely having:

- One in production

- One complete spare available and ready to use. During a large annual maintenance shutdown, the component in production can be replaced with the spare component or the up-to-date solution
- One in refurbishment

For the refurbishment of A-class components, Siemens VAI experts typically schedule an on-site meeting with the customer for a complete assessment of the customer’s needs. Repair solutions for A-class components cover welders, dynamic air knives, temper mills, strip levelers, scale breakers, roll coaters and plate levelers. Another added bonus is that up-to-date solutions can be implemented during the repair process in partnership with the suppliers. Customers are also invited to visit the Siemens VAI workshop, which also houses testing capabilities for ready-to-use components. The replacement parts are promptly delivered to the plant along with a detailed list of all necessary documents, including OEM recommended quantities and preferential prices. ■

Authors

Gilles Bernolin, Ludovic Bernon

Contact

processingline.metals@siemens.com

Siemens VAI Montbrison

Showcasing Top Workshop Performance

PROCESSING >

Since the 1960s, Siemens VAI has been a pioneer in developing new solutions for the metals industry. Especially evident in the company's Montbrison facility, the clear focus has been toward innovative and high-added-value machines that provide superior performance where they are installed. Mechatronic assemblies include a mix of mechanical, hydraulics, and automation in standalone packages within the line or mill.



To develop its equipment, Siemens VAI provides full in-house solutions from R&D to tested units, ready to be installed at site. The range includes controlled elongation machines and levelers, welders, air-wiping systems roll coaters, shears, surface-inspection systems, and shapemeter rolls. These machines have in common that they have been designed to ensure top performance beyond the capabilities of classic solutions, based on open automation systems and ease of maintenance.

A wide range of top performers

Controlled elongation machines include skin-pass mills, tension levelers and scale breakers. Other levelers include multi-roll machines for applications ranging from plate mills to finishing lines. Siemens VAI is the leader for these machines with about 500 references worldwide.

Mash-lap, flash-butt and laser welders manufactured at Montbrison address all mill and line applications from pickling and continuous tandem cold mills to finishing lines. The light-gauge laser welder is an innovative machine with one source ensuring both strip shearing and welding. The heavy-gauge laser welder has been designed for ultrahigh strength

steels with a fixed shear to ensure superior welding reliability.

Both air-wiping systems for hot-dip galvanizing lines and roll coaters for paint or chemical applications have a unique patented design geared towards coating savings and excellent ROI.

The wider product mixes with very-low- and ultra-high-strength steels require more from shears from both a capacity and productivity point of view. This has led Siemens VAI to develop a machine including the latest version of side trimmer with a dynamically adjustable width.

Surface-inspection systems with applications for hot and cold mills, galvanizing, annealing, cleaning and other finishing lines provide the highest level of detection and defect analysis. Shapemeter rolls for both hot- and cold-mill applications complete the portfolio.

An integrated process from design to test

In the integrated manufacturing process at Montbrison, equipment is designed using Solidedge 3D CAD software, which minimizes errors during prototype development; visualizes for customers the future production area, showing maintenance access and sight



Skin-pass mill area showing operator and maintenance areas

Tension leveler



Welding tests

Four laser welders under testing in the workshop

from operator stations; and transmits drawings from engineering to the manufacturing plant. The drawings are then used directly to create the sequence of machining operations on milling machines and lathes, as well as metrology sequences for quality control.

The Montbrison shop is organized around two bays: one for machining, welding and painting, and the other for equipment assembly and testing. Once the parts are machined and controlled, they are transferred to the assembly bay. For optimization of operations, the bay is divided into several sections according to the type of products: welders, skin-pass mills, levelers, air knives, coaters, shears, and a specific testing area for the shapemeter rolls. This ensures proximity to required utilities such as the resident hydraulic power unit and organization of tools, parts and steel samples when needed.

Once mechanical erection is complete, piping and cabling take place, followed by process control teams. Each machine is tested, in most cases, in a full workshop performance test. In many cases, customers also participate in the event to give final permission for equipment delivery to their site. The welding of customer samples, for example, is programmed to check both machine functionality and weld quality.

Equipment life-cycle management

A very important part of the success of machines manufactured in Montbrison is having teams involved along the entire product service life. Workshop mechanical engineers are often dispatched to customer sites, and process engineers in charge of shop testing supervise on-site commissioning.

Even after the equipment acceptance in the customer's plant, the Siemens VAI Montbrison workshop still ensures the availability of spare parts while providing the opportunity to study machine upgrades and adaptation to product-mix changes.

Welding campaigns are regularly organized to test new steel grades. A pilot line equipped with a temper mill and tension leveler also allows processing test coils, 300 mm wide maximum, for elongation capacity or roughness transfer efficiency. ■

Author
Roland Hequet
Contact
processingline.metals@siemens.com



Dedicated test bench for an HGC with a maximum pressure of 5,000 tons

Montbrison manufacturing

On Target with HGC Industrialization

The Siemens VAI Montbrison facility focuses on the production of rolling and processing equipment and high-value core components. The unit permanently adapts to market-price reality through benchmarking under the supervision of procurement offices within the Siemens VAI organization. To this end, a global program was launched three years ago to manufacture the hydraulic-gauge cylinder in the most efficient way possible.

The hydraulic-gauge cylinder (HGC) is the primary actuator in all roll stands, making it a major high-value core component. To manufacture this strategic component, Siemens VAI has invested significantly in 3D machining-programming software directly linked to the engineering 3D-design software and a dedicated numerical control machine tool, backed by a dedicated static and dynamic testing platform.

3D machine-programing software

HGC design is done in the Montbrison engineering offices using CAD software. The resulting 3D modeling of the part to be machined is stored in a CAD file that is then transferred to Unigraphics CAM software in the workshop.

Once the transfer to Unigraphics is complete, the movements of the machine tools are programmed. The programmer creates routes according to the choice of tools and determines cutting and forward speeds as

well as the machining strategies to be used. The CAM software then matches the chosen routes to the 3D modeling and converts the routes into equations.

The CAM software package is able to very efficiently simulate the action of the machining tools on the material graphically, which enables the programmer to check the machining strategy in advance and to prevent possible collisions with the bridling or gripping systems used to keep the material in place. The CAM system also allows Montbrison specialists to perform complete 3D modeling of the machine tool and to visualize the movements of its mobile parts (head, table, rotary axis) during machining simulations.

The result is a reduced number of mounting operations, which improves productivity and ROI.

Numerical-controlled machine tools

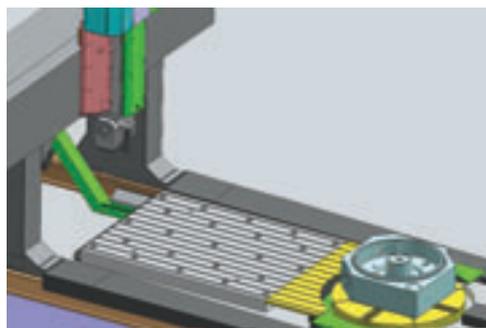
Taking into account the machining steps needed for an HGC, a milling center has been developed for an efficient industrialization process. Since there was no machine center available on the market for equipment the size of an HGC, Siemens VAI worked in close cooperation with French machine-tool manufacturer Forest-Line to develop equipment capable of isolating and combining machining phases like milling, turning, milling-turning, drilling-tapping, reaming and 5-axis machining.

The machine tool from Forest-Line is equipped with Siemens 840D numerical control, which receives ISO files generated by the CAM system and immediately translates them into machining instructions. The result is a reduced number of mounting operations, which improves productivity, ROI, and the efficient supply of the HGC to Siemens VAI.

Dedicated static and dynamic testing

After assembly of the individual mechanical, hydraulic and electrical components, all HGCs are validated and qualified at the testing platform. Both standard tests and specific tests are conducted in the Montbrison workshop.

Standard tests include record cylinder flushing to NAS 1638 Class 5, static pressure test for eight hours (maximum pressure facilities test bench of 5,000 tons) and the stroke measurement; a reliability test during a sine wave of maximum load; hysteresis measurement under different loads and at different positions; and instrumentation validation under pressure and



Machine center developed to mill and turn all types of cylinders

The CAD system generates, and simulates and defines the movements of the machine tools

with position sensors. Certain tests are typically conducted at the customer's request according to specific technical specifications using real hydraulic piping of the mill stand for simulation of the bandwidth record and manifold, and integrated cylinder responses.

Following this testing campaign, the HGCs are stamped with the Siemens VAI logo and sealed. They are then ready to be incorporated directly into any rolling-mill stand, and the time needed to commission equipment is significantly reduced. ■

Authors

Gerard Chevalier, Frederic Bosselut

Contact

processingline.metals@siemens.com

Interview with Wilson Ferreira de Souza, Steel Plant Director at Companhia Siderúrgica Nacional, Brazil

Ten Years of Outstanding Caster Service

Companhia Siderúrgica Nacional (CSN), the second-largest steel manufacturer in Brazil, operates an integrated production complex with an annual capacity of 5.8 million tons of steel. Since January 2000, the company has benefited from caster maintenance services provided by Siemens VAI. Karl Trnka, Operational Director of Siemens VAI Metals Services Ltda (Siemens VAI), spoke with Wilson Ferreira de Souza of CSN about the results of an excellent partnership.

What was CSN's main reason to outsource caster maintenance to Siemens VAI?

Wilson Ferreira de Souza: We simply lacked the maintenance know-how to ensure optimum performance of Slab Caster No. 4, which was commissioned by Siemens VAI at the end of 1999. Before the installation of this caster, we only had older machines that were built in the 1980s. We didn't have the technological background to properly maintain the casters ourselves, so we decided to sign a contract with Siemens VAI for this work.

Siemens VAI has been performing the maintenance work for the caster it installed in 1999 as well as for two casters from other suppliers. To what extent could the availability of the older casters be increased and how was this achieved?

Wilson Ferreira de Souza: Operational availability of the older casters could be increased by more than 30% on a step-by-step basis. The availability of the new caster is also better than expected. For example, there were only ten breakouts in ten years with the Siemens VAI caster, which we attribute to good organization, excellent technology and proper maintenance services. Siemens VAI always exceeded the targets we set. CSN and Siemens VAI enjoy a good working relationship with a clear focus on results. We have a very successful partnership.

What are some of the changes that Siemens VAI implemented to improve caster operations?

Wilson Ferreira de Souza: The nickel-plating facil-

ity for copper-mold plates and application of overlay welding for a longer lifetime of the rolls is certainly an important improvement at CSN. Modifications on the roller-cooling system in the older casters were also carried out in addition to various other smaller changes.

Operational availability of the older casters could be increased by more than 30% on a step-by-step basis.

In what other ways does CSN benefit from caster-maintenance services from Siemens VAI?

Wilson Ferreira de Souza: The outsourcing of caster maintenance allows our people to focus on operations and production. The quality of maintenance ensures that the caster runs smoothly and that component replacements and repairs are carried out according to schedule. Smooth operation also means that we can achieve new production targets more easily and without problems – such as increasing our output for the automotive industry. All of this is the result of good maintenance.

What are the main factors for a producer to consider when outsourcing caster maintenance?

Wilson Ferreira de Souza: A reasonable price and excellent maintenance knowledge on the part of the



Siemens VAI
caster maintenance work-
shop at CSN,
Brazil

Example of a
slab caster
straightener
segment
serviced and
maintained
by Siemens VAI



Wilson Ferreira de Souza of Companhia Siderúrgica Nacional (left) congratulates Karl Trnka, Siemens VAI Metals Services Ltda. on the successful ten-year caster-maintenance contract



provider. The technological know-how, maintenance background and workshop-management experience of your company were key factors that convinced CSN.

What advantage does the “cost-per-ton” payment model offered by Siemens VAI have in comparison with the former “menu-price agreement”?

Wilson Ferreira de Souza: The advantage of the cost-per-ton approach is 100% variable costs and the provision of maintenance services that meet our needs.

“World-class services at local prices” – that’s the claim of Siemens VAI. To what extent does this apply at CSN?

Wilson Ferreira de Souza: The statement is 100% true, even if your prices were not necessarily the lowest. But when we look at the final figures, the bottom line speaks for itself. ■

Contact
Karl Trnka
metallurgical-services.metals@siemens.com

Sinter Experts from Siemens VAI Win AIST Environmental Prize



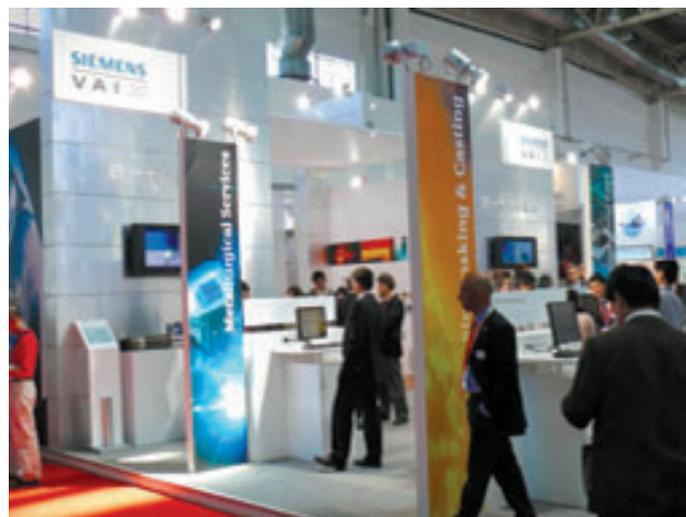
Receipt of Environmental Technology Award from AIST by André Fulgencio (left) and Dr. Johann Reidetschläger (right)

The AISTech is one of the largest conferences in the world for the iron and steel industry. At this year's event that took place May 3–6, 2010, in Pittsburgh, Pennsylvania, Dr. Johann Reidetschläger, Hans Stiasny, Stefan Hötzing, Christoph Aichinger and Andre Fulgencio of Siemens VAI were the winners of the "2010 Environment Technology Award" for the best paper and presentation. Of the 50 environmental papers presented at this conference and at a separate annual AIST (Association for Iron & Steel Technology) environmental conference, the topic "Siemens VAI Sintering Selective Waste Gas Recirculation System: Meet the Future's Environmental Requirements Today" convinced AIST's Environmental Technology Committee due to the simple, safe, practical and future-oriented advantages offered by this technology. Sinter-offgas recirculation to the sinter strand reduces the energy required in the sinter process, decreases CO₂ emissions and offers decisive advantages for both new and existing sinter plants. To request copies of the winning paper, please send an e-mail to sinterplant.metals@siemens.com. ■

Three in One

Metal + Metallurgy China, Casting China International and Refractories China took place under a single roof over four days in May. The three exhibitions provide a very comprehensive display of productivity solutions for the metals industry, from metallurgical machinery and equipment right up to end products.

Siemens VAI was represented at this year's event in Beijing with a 140 m² stand showcasing rolling and processing, iron and steelmaking, continuous casting, environmental solutions, and services. Visitors from Asia made up the largest part of the fair's attendance. Exhibits from the Shanghai workshops of Siemens VAI and Morgan – such as the refurbished bender-roller of a continuous casting plant – served as special eye-catchers at the stand. ■



The Siemens VAI booth

Customer Training For Roll-Housing Module Rebuilding

Siemens VAI Metallurgical Services Rolling, in a continued effort to improve the day-to-day operations of its customers' equipment, is holding a training course at its Worcester, Massachusetts, facility from September 20 to 23, 2010. The course is recommended for mechanics and technicians who repair roll housings as well as for those who perform daily maintenance duties.

The course includes comprehensive study of roll-housing maintenance along with hands-on practice of mechanical methods used to rebuild Morgan No-Twist Mill roll housings. After completion of the training, participants will know the function of the roll housing and will be able to identify the parts as well as properly rebuild and inspect the roll-housing assembly. Significant time will be spent on the proper use of Morgan rebuild tooling and its application in proper disassembly and assembly of the equipment. The knowledge contained within this course in conjunction with a consistent preventative maintenance plan is an excellent way to support the production goals of a facility.

Course outline:

- Mill inspections and seal changes
- Roll-shop-recommended equipment and tooling



Reassembly of No-Twist Mill

- Disassembly and cleaning
- Identification and replacement of damaged components
- Proper clevis-bearing installation and roller-bearing mounting
- Setting roll height and centerline reference
- Final assembly inspection

Contact: longrolling.metals@siemens.com ■

All About Mining

The Siemens VAI stand at bauma 2010 in April presented the company's portfolio for the mining industry and even included an exhibition of the world's largest truck engine. Visitors from all over the world come to Munich every three years for bauma, an international trade fair for construction machinery, building material machines, mining machines, construction vehicles and construction equipment. For Siemens VAI, bauma is the most important trade fair for the company's mining business. Attendance this year was high despite the travel ban due to volcanic ash: over 415,000 professionals from 200 countries attended bauma 2010. ■



4th Siemens VAI Media Summit in Essen, Germany

China and India Are Growth Drivers

Siemens VAI is strengthening its portfolio for iron- and steelmaking. “We will be investing some €35 million in China and India over the next years in order to expand our local production, engineering and project handling,” Werner Auer, CEO of Siemens VAI, stated to the international business and trade press at the 4th Media Summit Metals and Mining Technologies. This year, the international press event with more than 100 journalists from 15 countries took place in Essen, Germany.

In the future, Siemens VAI will not only develop and manufacture products and solutions in China and India but also launch them onto the global market. “This differentiates our strategy significantly from other market players,” Werner Auer said. “We are putting the business responsibility where it originates and can grow.”

In India Siemens VAI will be concentrating on selected raw-steel production technologies, whereas China will be responsible for new developments in the field of rolling. “Since the economic crisis, the competition in plant engineering has intensified significantly,” Auer reported. Whereas high-tech countries in Europe as well as the U.S.A. and Japan are continuing to focus on the efficiency and flexibility of their production processes, China and India want to produce, above all else, steel with simpler and cheaper plants to develop their infrastructure. “By transferring the responsibility to China and India, we are responding to the changes in the steel market and strengthening our leading position for the long term,” Auer said.

The second topic of the event was on innovations that save resources including water and energy in metals and mining applications. “Sustainability and cost effectiveness are not a contradiction,” explained Jens Wegmann, CEO of the Siemens Industry Solutions Division, and picked out the subject of eco-friendly solutions that help boost the competitiveness of mining and steel operations: “With climate change and an increasing scarcity of resources, the development of green products and solutions is gaining ever-



Werner Auer, CEO of Siemens VAI



more importance. Especially mining companies will have to invest more heavily in environmental protection and occupational safety in order to maintain their future viability and long-term profitability.”

As Bernd Zehentbauer, Senior Vice President of Mining Technologies at Siemens VAI, said, “Water shortages, rising energy costs and increasing social responsibilities in mining areas increasingly necessitate additional measures that affect profits. However, energy efficiency and water-treatment technologies are helping to maintain competitiveness.” New electric drives in trucks, shovels, conveyor systems and ore-crushing mills reduce energy consumption and therefore ease the demands on power-supply systems that are already very tight in many mining areas. Broadening the technology portfolio to include wastewater treatment is helping Siemens to ease the problem of water shortage.

In addition to the technical presentations, attendees took part in open discussions with Siemens management and had the opportunity to visit the open-pit lignite mine Garzweiler and the stainless steel plant of ThyssenKrupp Nirosta in Krefeld. ■

More information

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

Events: Upcoming Conferences and Fairs

- SEP 07 – 09** 9th INT. STAINLESS & SPECIAL SUMMIT, Rome, The Westin Excelsior, <http://www1.metalbulletin.com/events/1242/Europe/Iron-and-Steel/Venue-Information/9th-International-Stainless-and-Special-Summit.html?typeId=10&EventID=1242>
- SEP 12 – 15** EUROMAT 2011, Montpellier, France <http://euromat2011.fems.eu>
- SEP 14 – 16** ALUMINIUM – WORLD TRADE FAIR & CONFERENCE, Essen, Germany <http://www.aluminium2010.com>
- SEP 15 – 17** The 10th International Conference on Steel Rolling (ICSR), Beijing <http://hy.csm.org.cn/icsr10/en>
- SEP 19 – 22** METAL FORMING 2010 – 13th INT. CONFERENCE ON METAL FORMING, Toyohashi, Japan <http://plast.pse.tut.ac.jp/metalfforming>
- SEP 21 – 23** 2nd CHINA INT. SPECIAL STEEL INDUSTRY EXHIBITION, Shanghai, INTEX Shanghai International Exhibition Centre <http://www.supersteel.cn>
- SEP 21 – 24** WIRE CHINA 2010, Shanghai <http://www.wirechina.net>
- SEP 22 – 23** 5th Annual EU Iron Ore Insights Conference, London, The Bloomsbury Hotel <http://www.immevents.com/our-events/the-5th-annual-eu-iron-ore-insights-conference>
- SEP 22 – 24** ASIAN STEEL PACKAGING CONFERENCE, Malaysia
- SEP 26 – 28** OPTIMOM, Cambridge
- SEP 26 – 29** THE MAKING, SHAPING & TREATING OF STEEL: 101, Indianapolis, tbd, <http://www.aist.org>
- SEP 27 – 30** 40th ABM REDUCTION SEMINAR, Belo Horizonte, Brazil, <http://www.abmbrasil.com.br/seminarios/>
- SEP 29 – 30** 3rd SOUTH AFRICAN FERRO ALLOYS, South Africa, Hilton Sandton
- SEP30–OCT02** AIKW – Arbeitsgemeinschaft Internationaler Kalibreure und Walzwerksingenieure, A Coruña, Spain
- OCT 03 – 05** CONAC 2009, Monterrey, Mexico, Convex Center http://aistmexico.org.mx/conac/index.php?option=com_content&task=view&id=12&Itemid=27&lang=
- OCT 05 – 06** STAINLESS STEEL WORLD AMERICA 2010, Houston, <http://www.stainless-steel-world.net/ssw2010/ShowPage.aspx?pageID=1513>
- OCT 06 – 08** 14th ABM AUTOMATION SEMINAR, Belo Horizonte, Brazil, <http://www.abmbrasil.com.br/seminarios/>
- OCT 13 – 15** DUPLEX STAINLESS STEELS CONFERENCE & EXHIBITION 2010, Beaune, France, Palais de Congress, <http://www.stainless-steel-world.net/duplex2010/ShowPage.aspx?pageID=1644>
- OCT 17 – 20** 2nd INT. CONF. SUPER-HIGH STRENGTH STEEL, Peschiera del Garda, Italy <http://www.aimnet.it/shss2010.htm>
- OCT 17 – 21** AIST'S STEEL PROPERTIES & APPLICATIONS CONFERENCE + MS&T'10, Houston, The Materials Science & Technology Conference & Exhibition <http://www.aist.org>
- OCT 18 – 21** SMRP 18th ANNUAL CONFERENCE, Milwaukee <http://www.smrp.org>
- OCT 24 – 26** ILAFA 51– Latin American Iron and Steel Conference, Buenos Aires, Hilton Hotel <http://www.ilafa.org/>
- OCT 24 – 27** AMPT – Advances in Materials and Processing Technologies, Paris <http://www.ampt2010.org>
- OCT 26 – 29** 47th ABM ROLLING MILLS SEMINAR, Belo Horizonte, Brazil, Ouro Minas Palace Hotel <http://www.abmbrasil.com.br/seminarios/>
- OCT 26 – 30** EUROBLECH, Hannover, Germany <http://www.euroblech.de>
- NOV 01 – 04** 18th ROLLING CONFERENCE & 5th CONFERENCE ON USES OF STEEL, 5th CONFERENCE ON USES OF STEEL, Buenos Aires, City Center Rosario <http://www.siderurgia.org.ar/images/logo1-chico.jpg>
- NOV 10 – 12** China (Beijing) International Metallurgy Industry Exhibition, 2010, China International Exhibition Center
- NOV 10 – 13** 10th INT. MINING & MACHINERY EXHIBITION (IMME), Kolkatta, Salt Lake Stadium Grounds
- NOV 11 – 12** STAHL – “Performance for tomorrow,” Düsseldorf, <http://www.stahl-online.de/english/Stahltag/stahltag.asp>
- NOV 14 – 16** 26th INTERN. FERRO-ALLOYS CONFERENCE, Berlin, Hotel Intercontinental <http://www.metalbulletin.com/events/fa>
- NOV 16 – 17** STEEL SURVIVAL STRATEGIES, London, Marriott Hotel, Grosvenor Square <http://www.metalbulletin.com/events/ssse>
- NOV 16 – 18** Baosteel BAC 2010, Shanghai http://bac.baosteel.com/baosteel_bac4/index_en.jsp



The next issue of metals&mining –

Focus on Innovative Technologies and Solutions

Innovation is the driving force for any company that wants to thrive in the market and stay ahead of the competition. And with truly innovative products and solutions, new markets open up. In today's complex world, the lone inventor is a thing of the past. Instead, real innovations are developed in teams of specialists who work in tandem with research institutes, universities and customers. It typically takes years before an idea matures to a product that can be brought into production and applied on an industrial scale. But success is the reward of perseverance.

For more than 100 years, Siemens VAI has pioneered innovations for the metals industries. Technological highlights such as the implementation of Corex and Finex ironmaking and LD (BOF) steelmaking were truly revolutionary milestones in the steel industry. And we strive to maintain our tradition of innovation and excellence, particularly with the introduction and continued improvement of green and energy-efficient technologies that help producers not only meet the strictest environmental standards but also reduce costs.

The next issue of metals&mining therefore focuses on innovative technologies and solutions from the world of Siemens VAI, and presents an abundance of advantages and benefits for producers.



Reader Service

If you are interested in receiving a sample copy, or if you would like to order a free subscription of metals&mining, please send a fax to:

+49 911 978 3321

or an e-mail to:

metals@siemens.com.



DIALOGUE >

Keep in Touch.

Are you interested in the latest developments, innovations, start-ups, events and other news from Siemens VAI? Then subscribe to our new e-mail-based newsflash – keeping in touch couldn't be easier.

newsflash!

Sign up now: WWW.SIEMENS-VAI.COM/SUBSCRIBE



Keep up to date with the new e-mail newsletter from Siemens VAI.

Contact Address

Headquarters

Siemens VAI Metals Technologies GmbH

P.O. Box 4, Turmstrasse 44, A-4031 Linz, Austria

E-mail: contact.metals@siemens.com

Publisher

Siemens AG
Industry Sector
Industry Solutions
Metals Technologies
Schuhstr. 60
D-91052 Erlangen, Germany

Editorial responsibility in accordance with German press law

Alfred Baur

Editorial Staff

Sabine Fabris, André Fulgencio, Dr. Lawrence Gould, Berta Haring, Bernd Hoffmann, Henning Huschka, Stefan Lechner, Daniela Michel-Fracci, Dieter Perndl, Daniel Schmid

Publishing House

Agentur Feedback
Corporate Publishing
Friedrichstr. 22
D-80801 Munich, Germany

Printed by Mediahaus Biering, Munich, Germany
Publication date: August 2010
Circulation: 18,000

Order No.: E10001-M10-A13-V1-7600
Dispo No.: 21661 K. No.: 28105

Photo Credits:

Corbis, pp. 10, 13; Getty, pp. 1, 8; Dirk Vormann/Casino Zollverein, p. 38 and Thomas Willemsen/Stiftung Zollverein, p. 39; iStockphoto, p. 79.

All other photos courtesy of Siemens VAI.

Connect & Cast, Corex, Dynacs, DynaFlex, DynaGap Soft Reduction, Morgoil, No-Twist, Planicim, Siflat, Simanics LV, Simatec, Simatec PCS7, Simelt FSM, Simetal GCP, Simetal Gimbal Top, Simetal VAiron, Simovert Masterdrive, Siroll, Siroll CM, SmartCrown, Smart and WinCC are registered trademarks of Siemens AG and Siemens VAI Metals Technologies GmbH in certain countries.

metals&mining is published quarterly.

© 2010 by Siemens Aktiengesellschaft Munich and Berlin.

All rights reserved by the publisher.