



IN FOCUS

EXPERIENCING DIGITALIZATION

At METEC 2019, SMS group will be presenting the latest products relating to the digital future.

Visit us at
METEC 2019
Hall 5,
Booth E22

LEADING PARTNER

Big River Steel places follow-up order for the expansion of the most modern steel mill in North America. **14**

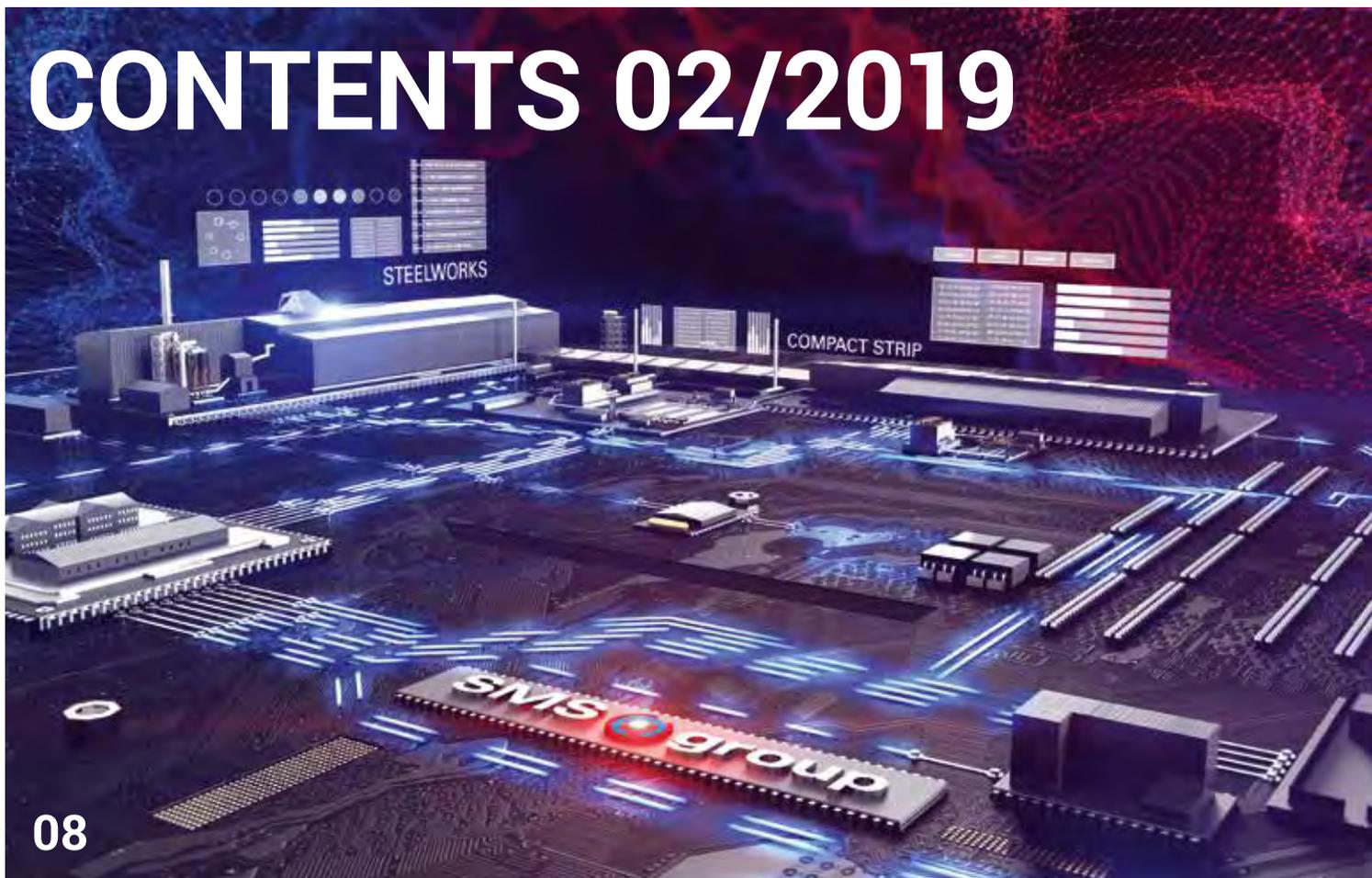
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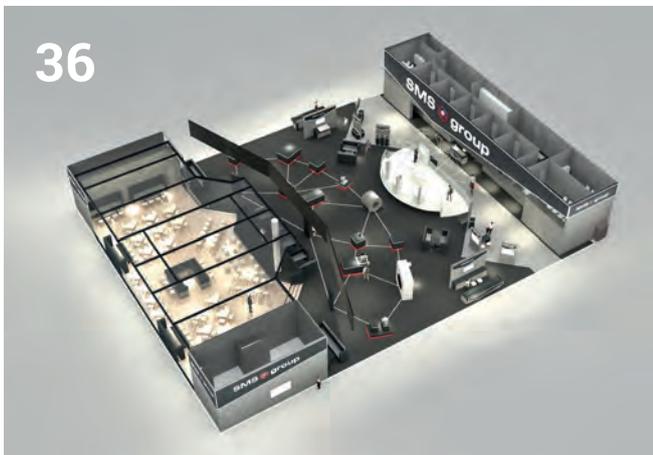
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WELCOME TO THE DIGITAL FUTURE

SMS group at METEC 2019

Dear friends of SMS group,

METEC is just around the corner. Experience the chances of your digital future and your smart factory in the steel, aluminium und nonferrous industries at METEC, THERMPROCESS, GIFA and NEWCAST 2019. Discover "The Bright World of Metals". At SMS group, we will present you concrete, digital solutions providing real added value and advantages in competition. We cordially invite you to visit SMS group in hall 5.

Trends

To us, these four international trade fairs feel like an inhouse exhibition as they are held right on the doorstep of our Düsseldorf location. I am proud to say that we have been part of METEC as a matter of tradition and, like scarcely any other company, we have constantly given fresh impetus to the whole trade as "Leading Partner in the World of Metals". And we will continue to do so at this year's trade fair.

METEC, THERMPROCESS, GIFA and NEWCAST will be visited by professionals from more than 120 countries. Four years ago, 78,000 experts came from all over the world. This makes the trade fair quartet one of the largest platforms for the exchange on new technologies, trends

and major topics. This year, the focus will be on the big future subjects of digitalization, Industrie 4.0, light-weight structures for the automotive industry and additive manufacturing.

And that is almost identical to the highlights we will present you at our booth. A matter of coincidence? Very unlikely. As partners to our customers we are very close to market activities and are one of the frontrunners in new developments. Together with our forward-looking customers we are leading the way. See and experience at our booth what that actually means.

Smart Factory

We will show you that the "learning steelworks" already operates with good results. In addition, we will introduce to you our latest, completely digitalized plants including Big River Steel in the U.S.A. and Shandong Iron & Steel Group Rizhao in China. Both companies are examples of how our solutions help digitalize the complete value-added chain from liquid steel to the final product.

Core components here are innovative solutions such as our cross-plant digital quality monitoring and optimizing system PQA® (Product Quality Analyzer). Or our Manufacturing Execution System X-Pact® MES 4.0 for production planning and control. We will show you the progress we made in terms of Machine Learning. In addition, you can learn more on how Augmented Reality supports and trains your maintenance specialists. Using eDoc will enable you to identify and immediately order spares directly at the machine. What's more, you will have the opportunity to immerse yourself in the virtual world and see your benefits with simulations based on Digital Twins. Become acquainted with our latest, intelligent sensor technology which provides the basis for digitalization and Industrie 4.0. Integrated in the plants, our sensors collect all required data in real time and make them available to the automation systems respectively for digital quality optimizations.

New Horizon

At the METEC exhibition, we will devote particular attention to the topic of new products we pooled under the overall strategy "New Horizon". They cover innovations and new business areas around our core competencies of metallurgical plant and mechanical engineering and include, for example, the very new opportunities offered by 3D metal printing. In this context, we can present you our pilot plant producing the metal powder needed for the Additive Manufacturing process, which is installed in our Mönchengladbach demo center. It is the largest industrial-scale pilot plant.

Our company Paul Wurth will show you innovative, eco-friendly and sustainable methods of metal extraction in line with "green ironmaking". Or let our experts demonstrate to you how we recover gold and other valuable metals from electronic waste with the UrbanGold process, using our vast know-how from furnace technology and modifying it for new applications. In a similar way, this also applies to our high-bay storage technology which offers the potential of revolutionizing container handling and storage in ports. The crucial factor here was the experience we had with heavy cargos in coil logistics.

Leading Partner Talks

The exhibits mentioned above just represent a small selection of the scope we are going to show you at our booth this year on an interactive basis. And it goes without saying that the event will provide a platform for the most important people to have their say: our customers and experts. Every day, reputed specialists from industry will open insights into their plants in our forum and describe their view of the results achieved in joint projects with SMS group. I am sure, these exciting topics will meet with your interest.

Big Pictures

As a matter of course we will introduce to you our numerous new developments in the field of metallurgical plant and mechanical engineering, since the new chances offered by digitalization would not be possible without



modern and future-oriented plant technology. At the trade fair, you can learn how we will accompany you as your full-service partner throughout the entire plant cycle from the steelworks to the casters and further to the rolling mills and strip processing lines – including our Technical Service. With higher yield, better quality, higher energy efficiency, environmental protection and sustainability.

Have I piqued your curiosity? We are looking forward to meeting you at the trade fair for face-to-face conversations. Let us help you gain an overview of how formerly separated areas are converging to a digital eco-system thanks to digitalization, and, above all, of how you can benefit from a partnership with our company.

We will meet at the trade fair – our experts are looking forward to seeing you!

Yours,

Burkhard Dahmen

Chairman Managing Board
of SMS group GmbH



U.S.A.

THE LEARNING STEEL MILL

Big River Steel in the U.S.A. is regarded as the first learning steel mill. All the facilities for the works were supplied by SMS group. For the second construction stage, SMS group will again supply Big River Steel with mechanical equipment, electrical and automation systems, and digitalization. More information on this order on page 14 of this Newsletter. ♦

**Axel Sprenger**axel.sprenger@sms-group.com

INTERVIEW

THE DIGITAL FUTURE HAS ALREADY BEGUN

Prof. Dr.-Ing. Katja Windt is a member of the Management Board of SMS group, responsible for the divisions SMS digital and Electrical and Automation Systems. In this interview, she speaks about the challenges of the digital future, their impact on the plant and mechanical engineering sectors and, above all, the benefits for the customers.

Professor Windt, what is the objective of digital transformation?

We want to help our customers get the most out of their machines and processes. Our approach is to combine technology with smart logistics and digitalization solutions that generate added value for our customers. Already today, we offer a range of new products and services based on digital technologies. With these solutions we achieve significant efficiency improvements along the entire supply chain.

Does digitalization change the way mill owners operate their plants?

Yes, indeed. Digitalization has an impact on strategies, processes, structures and products alike and will lead to sustainable change in the companies taking part in the value added chain. People, machines and commodities will in future communicate in real time. Learning algorithms will transform the value creation chains into dynamically acting value creation networks.

Could you please describe this in more detail?

For companies, the road into the future leads to a digital eco-system. This is a complex network of business functions and business processes interacting with manufacturing machines, computers, software functions and human players. It permanently communicates, analyzes, monitors and trains itself. The digital eco-system learns and improves continuously as it is constantly trained to get closer to the desired target scenarios. Based on intelligent pattern recognition algorithms, it is able to predict scenarios, it knows the consequences resulting from incidents taking place in reality, and it knows what all this costs. The objective of the digital eco-system is to maximize the overall yearly profit of a company along its entire production chain. This calls for the complete production chain to be optimized along all processes involved – from the incoming material via production down to the shipment of the product to the end customer.



This sounds rather complex.

This holds certainly true for the digital technologies and as far as the amounts of data are concerned. But the human operators will receive best possible support in performing their tasks and in decision-making. A key requirement, however, is that the eco-system has a robust and flexible data architecture based on a platform infrastructure. It will integrate different production facilities with different data provision structures. In reality, this will often be a mix of newer and older machines or automation systems. Our experts will combine all this into one consistent system for our customers.

Will the steelworks of the future be able to learn and optimize itself?

Not only in the future. This is feasible today! We have already implemented various projects with a focus on digital solutions. The learning steel mill, which we have erected in the U.S.A. together with our customer Big River Steel, is an outstanding example of such projects. The smart steel mill con-

tinually optimizes the production process from the raw material all the way down to the finished product as part of an integrated supply chain. This is achieved by the use of process know-how and expertise as well as physical and data-controlled models.

Is there something like a Best Practice or a roadmap to digital transformation for the customer to follow?

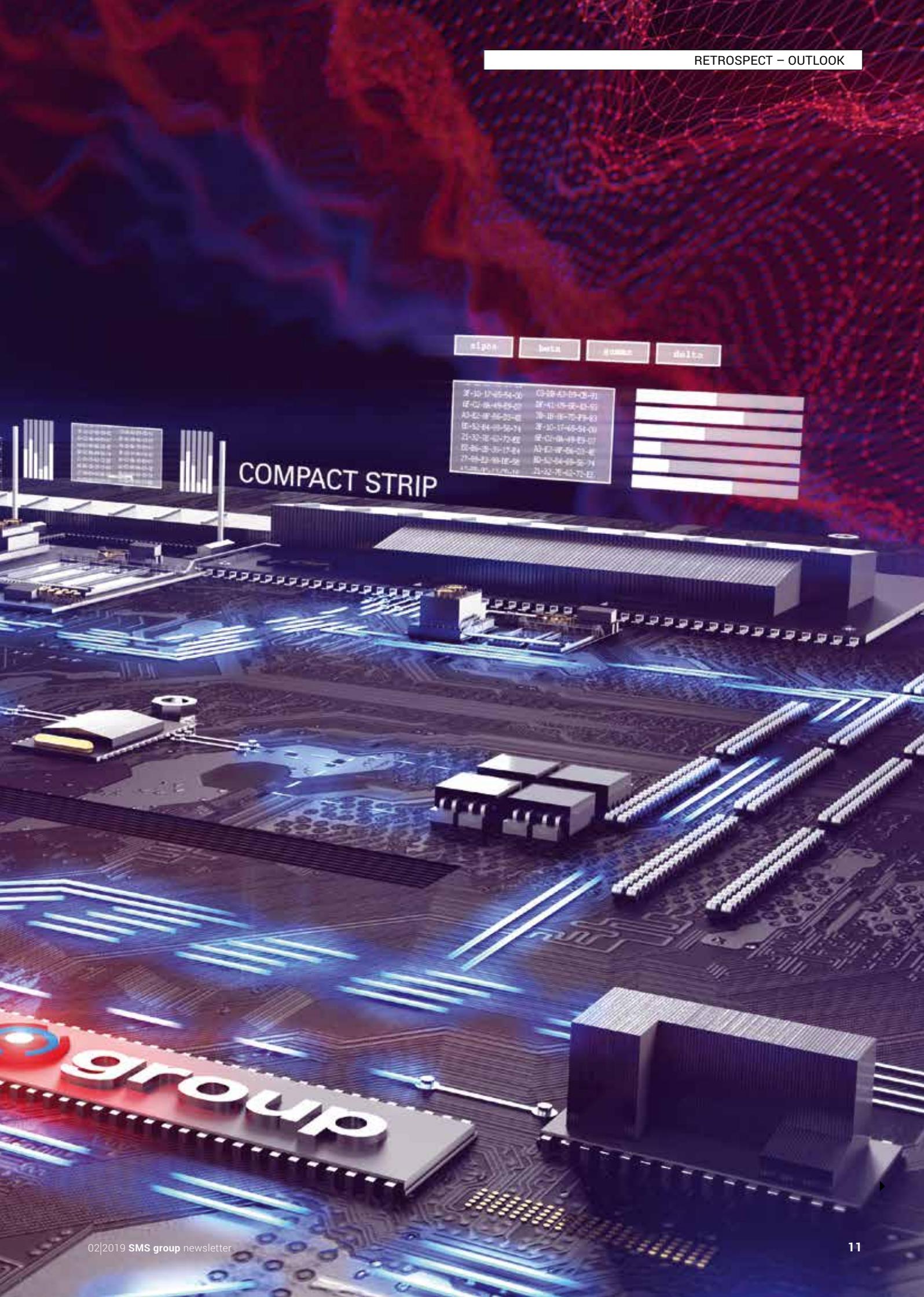
Worldwide, we have gained very good and very successful experience. Nevertheless, the task is not an easy one because steel production means that a great many challenges have to be coped with at the same time, all of which have a direct impact on the business result. I'm referring to flexible production planning and production control for varying lot sizes, even single items, while achieving timeliness of delivery and short lead times; to maximum plant performance at minimum maintenance effort and little locked-up capital; to reproducible attainment of best product

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STEELWORKS

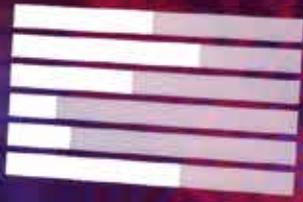
**“BIG RIVER STEEL
SHOWS HOW WELL
OUR SOLUTIONS
INTERACT.”**



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COMPACT STRIP



 **group**

quality at high yield and without high inventories. All this is taking place under circumstances such as legal requirements, environmental standards, resources, and costs of raw materials, energy and personnel. When we develop a solution, we have to take all these aspects into account - with a view to the specific requirements of the individual customer and within a to-be-defined target conflict corridor.

As you start out with different customer requirements in each case, how do you go about developing a solution?

The target scenario consists of three main elements. First: real-time control of production planning. Second: plant condition monitoring. And third: monitoring and assuring product quality. All three together form the key to the success of the company. At the same time, they are closely interlinked. Production planning, for example, needs real-time information about how well the production targets are met, that is information about productivity and capacity utilization, the plant condition, the achieved product quality and adherence to delivery dates. This is the only way for the plant operators to ensure compliance with customer specifications. On the other hand, maintenance needs information about the current status and condition of machines and components as well as about resource and capacity requirements for the planned production. This is needed to ensure that the required product quality is actually producible with the current condition of the plant. The product planning requirements are assessed, documented and adapted, if necessary. All this has to be performed in a holistic way.

What makes a steel mill smart?

This becomes obvious and can be experienced by our customers in many ways. Let me just describe one scenario out of many: In a smart steel mill, the centralized, rigid and hierarchical production planning process is being gradually replaced by real-time production optimization. This is a fundamentally different approach because planning becomes an agile process based on real-time data from production. Production planning takes into account any change in circumstances, for example, new orders, imminent maintenance activities or quality deviations, generates alternative scenarios autonomously and evaluates these scenar-

ios. The result is a parameterization on the basis of learning algorithms.

You have mentioned the customer Big River Steel. What kind of digital solutions from SMS group have been implemented there?

For Big River Steel, we supplied all plant components complete with automation systems and associated technology packages. Practice has shown how well our solutions interact and that they provide a long-term benefit for the customer. The plants we supplied range from the meltshop via the rolling mills down to strip processing lines. The mill produces high-grade strips. Let's have a closer look at the digitalization solutions and the way they interact along the entire process chain. Here we talk about production planning, business intelligence, plant condition monitoring as well as control and assurance of the product quality.

How does production planning work at Big River Steel?

From the very first day of production, Big River Steel has been using the SMS X-Pact® MES 4.0 system for its production planning and control. Our system is designed to perform smart and mainly autonomous production planning in real time. As part of our ongoing digitalization offensive, we have kicked off a research and development project on "intelligent production planning" in cooperation with Jacobs University of Bremen, Germany. The project covers aspects such as dynamic reacting to specific production situations, use of artificial intelligence and self-learning automation systems. It is planned to integrate these dynamic planning and optimization processes into the existing X-Pact® MES 4.0 structure in place at Big River Steel. They will yet further improve compliance with production plans and timeliness of delivery, and increase the yield and the economic efficiency of the mill.

In which respect can Big River Steel benefit from the business intelligence system?

We have implemented our X-Pact® Business Intelligence system which comes with various options for interactive analyses and a comprehensive web reporting system. It visualizes the production processes and the related input data in clearly structured dashboard views, while processing the information in the desired level of detail in each case.

X-Pact® Business Intelligence allows Big River Steel to merge large amounts of detail data in a clearly structured way at a central point so that a system analysis can be performed or a strategy developed swiftly and at any time desired. Across the mill location, management and the operating and engineering staff have access to the current and transparent strategic key performance indicators.

Presumably, new concept types have to be conceived in order to be able to continuously monitor the condition of plants in a steelworks of such scale?

For this task, we have implemented our Genius Condition Monitoring® solution. Being a platform-based concept, further modules can be added at any time. Thus it is suitable for all tasks ranging from single-component monitoring through to holistic, plant-wide monitoring. Also existing plant components can be retrofitted, with latest sensing equipment, for example, for gear monitoring by monitoring torques, vibrations, temperatures, the volume and particle contamination of oil flows, viscosity and many more. Unlike other analysis systems, Genius Condition Monitoring® does not compare the measured values with rigid threshold values, but with expected values and tolerances derived by physical or data-based models – individually for each load case. Via a trend analysis function, it is possible to predict the probable date of failure for the planned production program. This avoids unexpected downtimes and allows necessary maintenance activities to be initiated in due time.

And how can the product quality eventually be monitored?

The product quality is monitored and assured by our Product Quality Analyzer, PQA® for short, in combination with our Quality Execution System (QES). This is definitely one of the most compelling solutions in connection with digitalization. At Big River Steel, the PQA® system captures quality data and quality-critical process parameters for all products along the complete process chain – from steelmaking all the way to the finished product. PQA® creates works-wide transparency of the relevant quality and process data down to the complete genealogy of the products. Quality monitoring relies on the integration of expert knowledge that is stored in rule sets and expanded continu-

ously. Thus the system can take product quality decisions in real time and directly intervene, should any deviations be recognized. Also our production planning system X-Pact® MES 4.0 plays its part by correlating the results and actively responding to quality deviations by re-assigning the product to another order or initiating a new order. This is very supportive to the philosophy of make-to-order.

Doesn't this sound like machine learning?

Absolutely. In future, we – and, of course, our customers – will make quality predictions using machine learning techniques and uninterruptedly evaluate the available data for causes of quality deviations. All this will take place in parallel to the running production. In this way, the aimed-for, self-learning quality monitoring processes of digitalization become reality. In this context, our QES/PQA® system will play a key role in connection with other solutions we provide and with our plant technology.

As these developments continue to unfold, what is going to happen to the operating staff?

The plant operator will in future receive best possible support in the performance of his tasks and in decision-making. He will no longer have to search for information in different data file formats or sometimes obsolete hard copies, and interpret the data by himself. Quality is never generated in the last process step, but evolves along the production chain. Here our digital technologies open entirely new perspectives, bringing to light relationships between data and, consequently, between process and product parameters – relationships that were not visible in the past. In this way, we generate new knowledge from data and added value for our customers. ♦



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U.S.A.

PROFITABLE THANKS TO DIGITALIZATION

Big River Steel is going to work with SMS group also in the second construction stage of its steel plant in Arkansas. SMS group will supply the mechanical equipment, electrical and automation systems, and digitalization. ▶

Big River Steel is going to expand North America's most environmentally friendly steel mill with support by SMS group.



Based on steel scrap, Big River Steel produces state-of-the-art materials.



DIGITALIZATION THAT GIVES PLEASURE

Those responsible at Big River Steel talk about their experience with digitalization implemented by SMS group and its effect on the production process.

- **Mechanical equipment, automation and digitalization** will be supplied from one single source.
- **The PQA® (Product Quality Analyzer) system** will be a central module of the process automation system also in the second construction stage.
- **The expansion** is to raise the mill's annual production to about three million tons of steel.

U.S. steel producer Big River Steel has commissioned SMS group with the expansion of its steel plant in Osceola, Arkansas. Since commissioning of the new mill in 2017, Big River Steel has been producing high-quality steels, ramping up product development efforts to make tube grade sheet for pipeline construction, silicon steels for a wide variety of energy and motor applications, and advanced high-strength steels for the U.S. automotive industry.

SMS group will again supply Big River Steel with mechanical equipment, electrical and automation systems, and digitalization. The expansion is to increase the mill's annual production to about three million tons of steel.

ONE OF THE WORLD'S WIDEST CSP® PLANTS

After completion of the next expansion, the steel plant will have two electric arc furnaces and two twin-ladle furnaces. Installation of an additional gas cleaning system will ensure compliance with the strict environmental legislation. A second casting strand, a second tunnel furnace and a further downcoiler will be added to the CSP® plant. Big River Steel's CSP® plant produces up to 1,930 millimeters wide coil, making it one of the widest CSP® plants in the world. The hot ▶



"SMS group and Big River Steel has seen a more encompassing relationship than I've previously ever had with SMS group on some of my projects. SMS group has not only been involved in the technology supply, in the mechanical and automation supply, but now also in the digitalization supply. And as I look back on the decision to take both the mechanical, automation and digitalization supply under one roof, we certainly have had challenges but overall that was the correct decision. Having all three of those components housed within one organization has benefitted Big River Steel by allowing us to have a faster start-up than any other minimill ever in the world."



A video with impressions and statements about the digitalization at Big River Steel.

"The digitalization efforts that we have put in have been a significant component of Big River Steel's early success. Whether it be the early months of production records, whether it be the extremely high profitability, whether it be our ability to go 140 days in a row without a breakout in the caster. That is unheard of. If you look at the mill uptime that we have, even though we have only been operating for two years and we are still getting our systems all dialed in, I have seen great, great success in the digitalization."

David Stickler, Chief Executive Officer, Big River Steel

“I’m very proud to work for the first learning factory. And I’ve been in this industry for almost twenty years and seen a lot of different technologies. It’s truly exciting to work with the next generation of steelmaking capability.”

*Keith Shuttlesworth, Chief Commercial Officer,
Big River Steel*



coil produced in the CSP® plant is processed into high-grade cold strip in the downstream coupled pickling line/tandem cold mill. Also as part of this project, the continuous galvanizing line (CGL) will receive an additional coiler. For all the newly installed plants, SMS group is going to supply the mechanical equipment and the X-Pact® electrical and automation systems, including level 3.

BIG RIVER STEEL PURSUES ITS STRONG FOCUS ON DIGITALIZATION

Also in the second construction stage, the PQA® (Product Quality Analyzer) system developed by SMS group company MET/Con will be a central module of the process automation system. By capturing and evaluating all relevant production data on a continuous basis, PQA® monitors, documents and assures the product quality down to the finished cold strip along the complete production process.

The system uses stored rules defined on the basis of expert knowledge to assess the coil quality in a semi-automatic procedure and, based on these assessments, takes “ship” or “block” decisions for the downstream processing of the strip or its dispatch. The system sends instructions for action to the operators while production continues in order to make them aware of any onset of irregularities within the production process and suggest countermeasures to be taken. This allows the operators to predictively intervene in the process before an incident becomes a problem, dramatically reducing the occurrence of failures along the production process which otherwise might have resulted in poor quality and downtimes. In the long run, the system provides higher yield while increasing the product quality.

The expansion project is rounded out by SMS group’s Technical Service which includes, among others, spare part management services.

LEADING PARTNER TALK

David Stickler, CEO of Big River Steel, is going to talk on the current project at METEC’s SMS group booth as part of a series of interviews.



“When it comes to recommendation to other mills, I think that one of the things we have demonstrated at Big River Steel by hosting all potential SMS customers coming through this mill and not only hosting them but telling the stories of our success and reflecting upon the capability and SMS group contribution to our journey so far. So absolutely, we will certainly recommend and continue to recommend SMS to their potential customers in the digitalization space. Not only that but also the overall industrial space of equipment supply.”

Sabyasachi Bandyopadhyay, Chief Technology Officer, Big River Steel

David Stickler, CEO of Big River Steel, commented on the SMS group order, “I have purchased several technologically advanced steel production facilities from SMS over the past twenty years and I am fully confident that SMS group will again deliver a high-quality mill that sets the standard in terms of product capability, energy efficiency and environmental sustainability.”

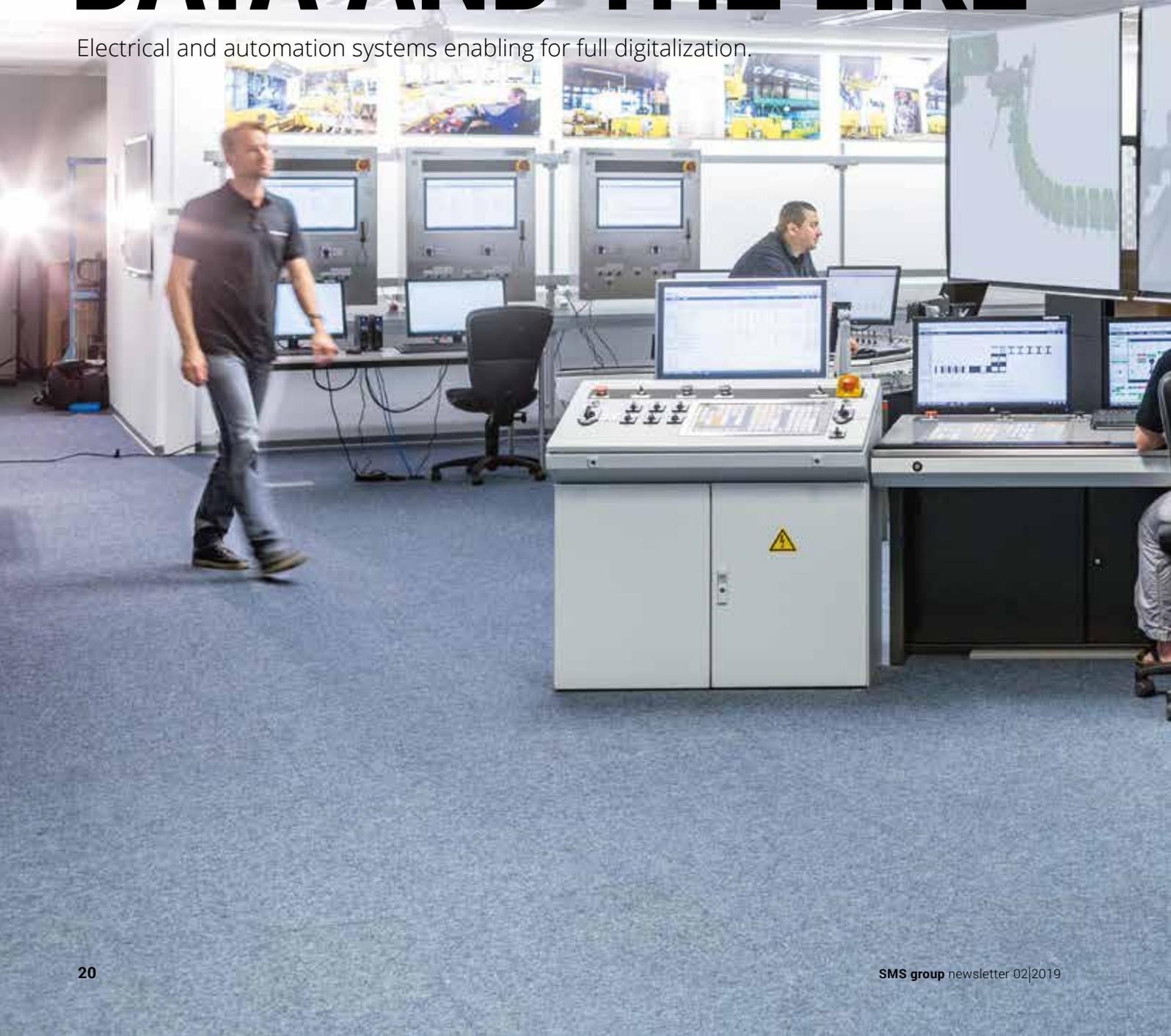
Burkhard Dahmen, Chairman of the Managing Board of SMS group stated: “Working closely with the management and staff of Big River Steel, we have succeeded in digitalizing a highly complex steel plant in a way that meets the targets of stable and resource-saving production. We are very pleased about Big River Steel’s decision to also award us the order for the next expansion stage of the steel plant and to continue on the proven successful way with SMS group as their partner.” ♦

 **Axel Sprenger**
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WORLDWIDE

PREPARED FOR INDUSTRIE 4.0, BIG DATA AND THE LIKE

Electrical and automation systems enabling for full digitalization.







LEADING AUTOMATION EXPERTISE

The proven solutions SMS group offers in the field of electrical and automation systems are summarized under the term X-Pact® (process, automation, control, technology).

- **The X-Pact® packages** offer tailor-made solutions for complete automation and digitalization.
- **X-Pact® Process Guidance** provides an intelligent connection and systematic networking of knowledge and data thus setting a new standard in plant automation.
- **Plug & Work tests** permit the customized plant automation system to be tested prior to the plant erection and commissioning at the customer's site.

With X-Pact® Leading Automation, SMS group offers the complete systems expertise along the entire metallurgical process chain. Their highly flexible modular design makes the X-Pact® packages a key element in the successful implementation of plants. X-Pact® makes sure that all of the customers' plant components operate in perfect harmony – from ener-

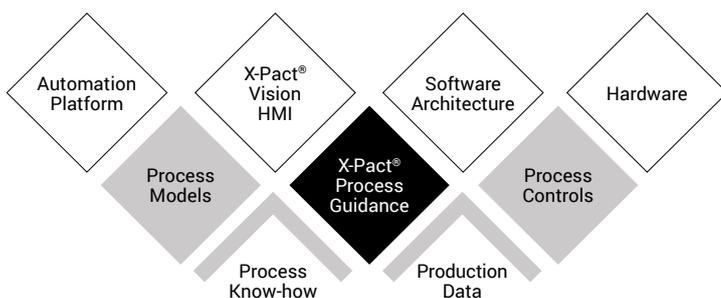
gy supply and distribution to drive technology, further to instrumentation and automation and finally to production planning. Operating closely with its customers, SMS group develops tailor-made solutions and future-oriented technologies in line with each customer's wishes and is hence in a position to implement complete automation and digitalization environments.

SMS group combines classical mechanical engineering and innovative digital services, thus creating added value for its customers along the entire value-added chain. Essential factors here are embedded systems, digital service platforms, real-time networking of plant data, big data analytics, cloud computing for self-optimizing and autonomous process control.

A learning steelworks features an intelligent and largely autonomous production process. But how can a plant learn? This is very simple to answer. It uses data and derived information as a basis for decisions relevant for process control and operations.

Using X-Pact® Process Guidance, SMS group sets a new standard in plant automation in that it provides intelligent connectivity and systematic networking of knowledge and data. The real-time information hub that supports all usual Industrie-4.0 communications standards for digital products permits new sensors to be connected in almost no time. After their validation, process data can be exchanged between different systems, as for instance the energy management system or the plant condition monitoring system. To ensure safe communication, sophisticated authentication takes place in addition to common encryption methods. A uniform style

New innovative standard in X-Pact® Leading Automation



guide of X-Pact® Process Guidance gives all plants from SMS group the same graphical appearance.

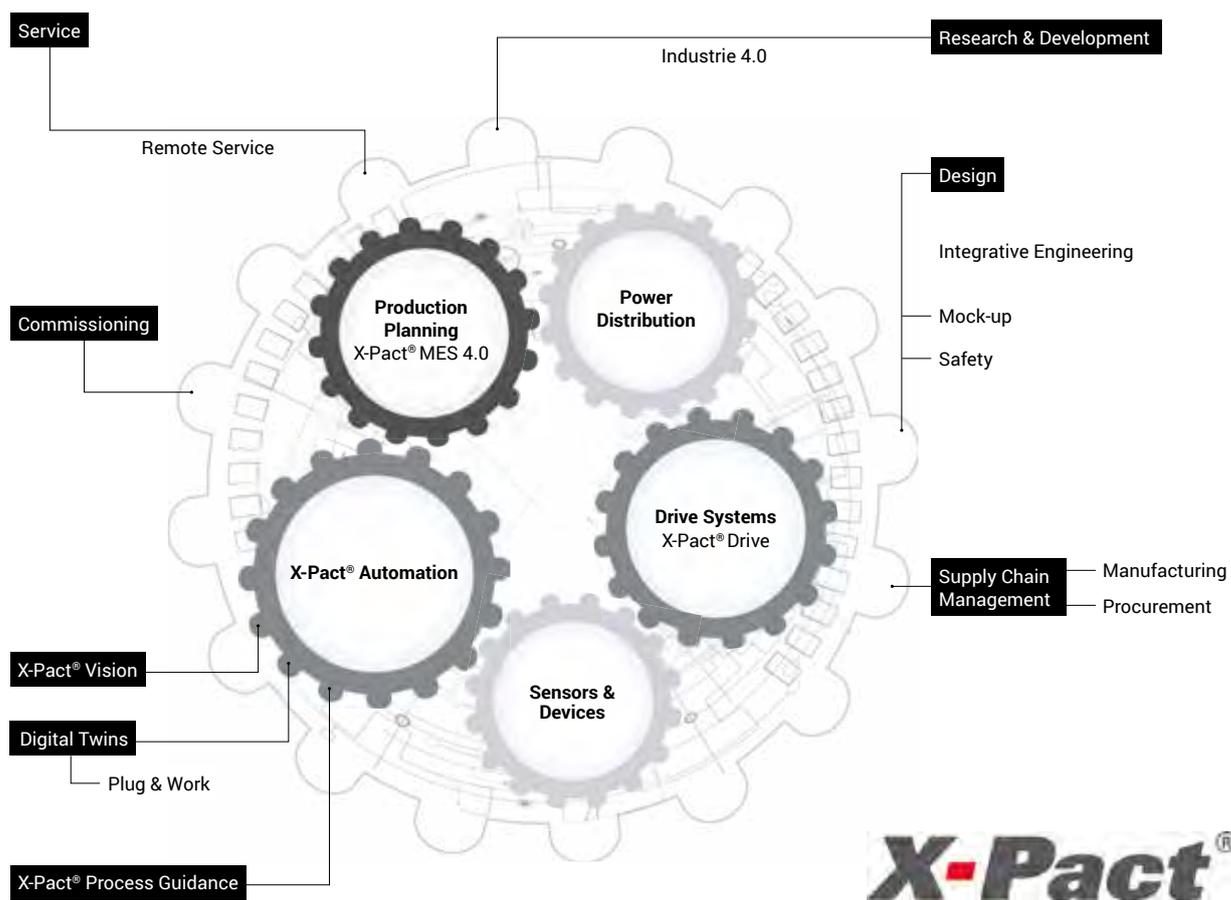
TRENDSETTING TECHNOLOGIES

X-Pact® Process Guidance moreover features a wide variety of virtualization functions. Virtualization promotes the creation of redundant capacity to increase plant availability and makes independent of the system hardware.

As the X-Pact® Automation features a consistently modular design, it is easy to integrate classical modules like reporting, tracking, material management and process models. New

benchmarks are also set by an innovative software architecture thanks to the run-time flexible, service-based networking of automation functions.

Along with the growing digitalization of production facilities, SMS group has developed systems capable of ensuring comprehensive quality control and achieving optimization of production processes in terms of throughput and plant utilization. Incorporated in these systems are cutting-edge, intelligent planning tools that are increasingly based on artificial intelligence. In the learning plant, the currently applied, traditional medium- to long-term production planning process is replaced by a ▶



PERFECTLY HARMONIZED
 X-Pact® provides tailored, digital automation solutions for the entire metallurgical process chain. The system ensures the systematical networking of knowledge and data and is the central basis of the vision of the “learning steelworks”.



AN EYE ON PRODUCTION

Real-time production planning is the ultimate objective of plant operators. Virtualization and artificial intelligence help take a big step in that direction already now.

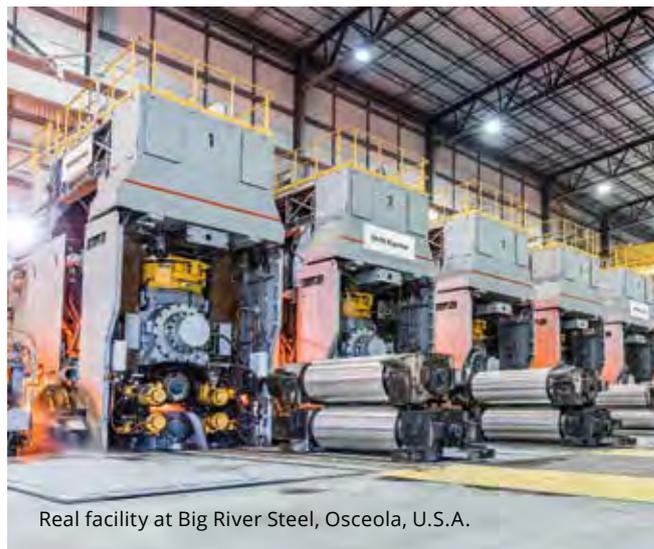
self-optimizing production planning system in real-time like X-Pact® MES 4.0. SMS group's metallurgical know-how allows for advanced production planning and control, and substantially contributes to its customers' success in business due to the optimization strategies applied (please refer to the article on artificial intelligence in X-Pact® MES 4.0 systems starting on page 28).

The key elements include the tool X-Pact® Business Intelligence with interactive analysis options and an extensive, sophisticated web reporting system offering a clearly structured and comprehensive visualization of the production processes on the dashboard. The information

is presented in the required level of detail according to the operator's input.

DIGITAL TWINS

Digital commissioning of the customer's automation systems takes place as early as during the Plug & Work test. The Plug & Work concept developed by SMS group permits valuable time to be saved already in the forefront of the plant erection and commissioning. A new automation system is completely installed, tested and pre-optimized in the test fields of SMS group a long time before erection work on site is going to start. This is possible thanks to a realistic 3D



Real facility at Big River Steel, Osceola, U.S.A.



Comparison of the real facility and its digital twin.

real-time plant simulation reproducing a digital twin that features the same functions and technology as the plant for the specific customer. Within the scope of the Plug & Work test, this simulation is connected to the automation system of the plant to be tested and serves as substitute of the real plant. On that occasion, SMS group employees can train the future operating staff at the original control desks. In the virtual production process, the customer's staff has the opportunity to familiarize with and master the functions of the plant and its handling in realistic operational situations. Using Plug & Work can cut the time needed for commissioning by up to 30 percent compared to the ▶

REALISTIC 3D PLANT SIMULATION IN REAL TIME

- To save valuable time in the forefront of the plant erection and commissioning, new automation systems are tested by SMS group in advance. For this purpose, a digital twin is created of the customized plant. This twin is connected to the automation system by means of a realistic 3D plant simulation in real time, then tested and pre-optimized.
- This so-called Plug & Work test may also be used to train the operating staff at the original control desks. This way, the commissioning time can be reduced by up to 30 percent.

SMS group test center in Hilchenbach.



EXPERIENCING INNOVATIONS

Many customer delegations visit the Mönchengladbach test center to experience live the virtual production by various plant types during digital commissioning and to gain an overview of the current innovative concepts offered by SMS group for the implementation of a learning steelworks.



The Mönchengladbach test center is also the creative hub of the Business Unit Electrics/ Automation. Like in an innovation lab, this is the place where new, innovative future trends in plant automation are developed and implemented.

conventional proceeding. SMS group's Plug & Work is a concept that has been tried and tested over a long term and is continuously improved to meet the requirements of the new industrial age.

At numerous locations worldwide, SMS group operates Plug & Work test centers and training facilities. At these specifically equipped test fields, original control desks, switch cabinets and automation systems are installed and configured according to the individual requirements of the customer. Then, all hardware components have to pass a function test to discover and remedy possible defects already in advance. The benefit for the customer is that he can rely on receiving faultless and thoroughly tested software. ◆

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WORLDWIDE

AUTOMATIC SURFACE INSPECTION

With SurfTec, users get not only detailed images of the product surface but also information on size, position, frequency and classification of surface defects detected.

TBK Automatisierung und Messtechnik GmbH, a 100 % affiliate of SMS Beteiligungs GmbH, intensifies activities in the field of the automatic surface inspection system SurfTec. Developed as an extension to the successful dimension measuring systems MEERgauge® and PROGAUGE, SurfTec has – compared to competitors – evolved into a unique selling point for the measurement of hot rolled products.

TBK implements the laser light-sectioning method for three-dimensional measurements of geometries in a technologically leading way. Based on this method, SurfTec provides detailed images of the product surface and delivers automatically detected surface defects along with their key attributes such as size, position, frequency, and classification. SurfTec utilizes raw measurement data of the robust and proven laser sensor system for dimension measurements and thus eliminates both costs for additional roller table reconstruction and risks of damage for additional sensors in the harsh rolling environment.

Current developments are aimed towards higher scanning rates, online 3D visualization and the exploration of new mar-

kets. Recording rates of 15,000 – and even more – full cross sections per second open a so far unknown view to the surface of fast moving products such as hot rolled wires. The data are prepared accordingly to make the measurement results intuitively accessible for the operations team. Especially with complex profile contours, the 3D view of the measured surface (either with a colored surface map or as 3D rendering) and the defect visualization as distinctive color overlays support the interpretation of measurement and inspection results as well as the decision for necessary interventions in the rolling process.

Over the past few months, TBK has also succeeded in gaining a foothold in the sensitive Japanese market. Still in this year a PROGAUGE PRG800-8H including SurfTec for beams and sections will be delivered to Nippon Steel Sumitomo Metals, Kimitsu works. ♦

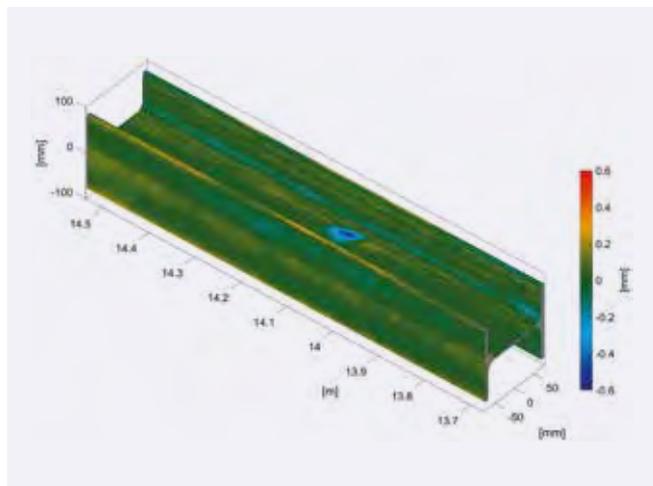


Contact

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Laser-based dimension measurement and surface inspection on hot H-beam.



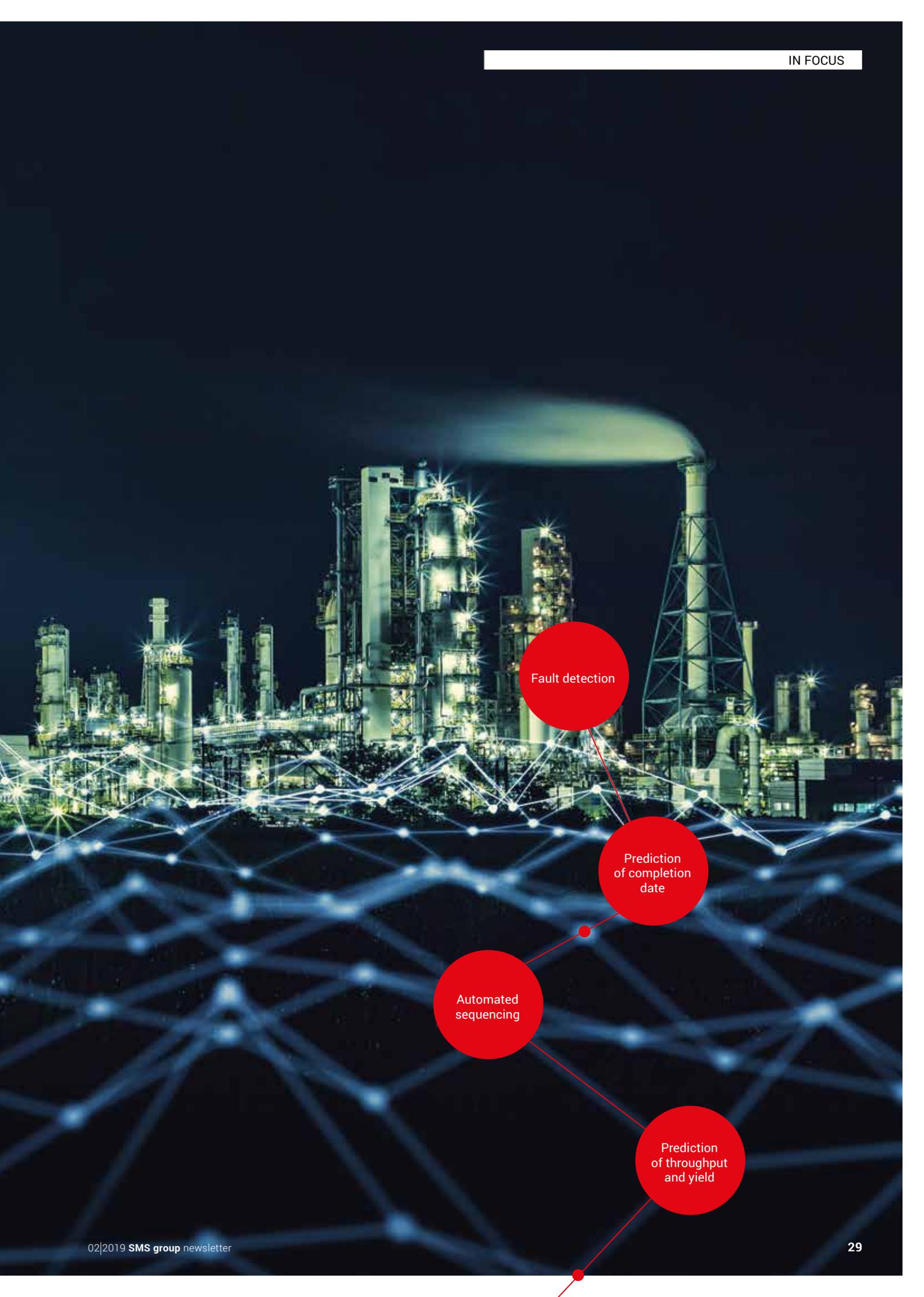
3D visualization of automatically detected crack on H-beam web.

WORLDWIDE

SMART SOLUTION FOR THE PRODUCTION PROCESS

Supported by artificial intelligence, X-Pact® MES 4.0 optimizes business processes. The result: less time lost and lower costs in production and warehousing.





Fault detection

Prediction
of completion
date

Automated
sequencing

Prediction
of throughput
and yield

- **Numerous modules** within X-Pact® MES 4.0 apply artificial intelligence methods, as for example fault detection and production planning.
- **Historical production data** are the basis for evaluation and planning. They serve to train the underlying data model.
- **Smart support** by artificial intelligence relieves the staff and accelerates individual production steps.

The X-Pact® MES 4.0 (Manufacturing Execution System) supports customers of SMS group around the globe in the planning and monitoring of their business processes. In addition, the system follows the material flow during production. This way, it is possible at any time to track as to when which kind of material is produced and where it is at any specific moment. In order to optimize production planning, X-Pact® MES 4.0 increasingly uses artificial intelligence methods (AI) such as machine learning and big data analysis. Numerous modules of the MES system feature different methods that care for, among others,

- early detection of deviations in production
- prediction of completion date
- automated sequencing
- prediction of throughput and yield.

For this purpose, historical data are consulted for future planning, to be able to derive forecasts for the future. The representation on the page on the right shows the working process of this so-called data-driven approach.

In the modules overview of X-Pact® MES 4.0 (page 35), all modules that have been extended by artificial intelligence are marked with AI.

Early detection of faults and anomalies in production

Artificial intelligence is able to recognize unknown relationships between different input parameters and to detect interferences there

at an early stage. This offers the opportunity to initiate measures and cut economic losses.

In a specific case it was found that strip temperatures at the coiler of a CSP® line was suddenly significantly diverging from the target value. As such temperature deviations deteriorate the material properties of the coils, the cooling water volume was automatically adapted for the following coils, reducing the difference between the actual and set values.

Nevertheless, due to the temperature deviations during production of the preceding strips these had to be downgraded.

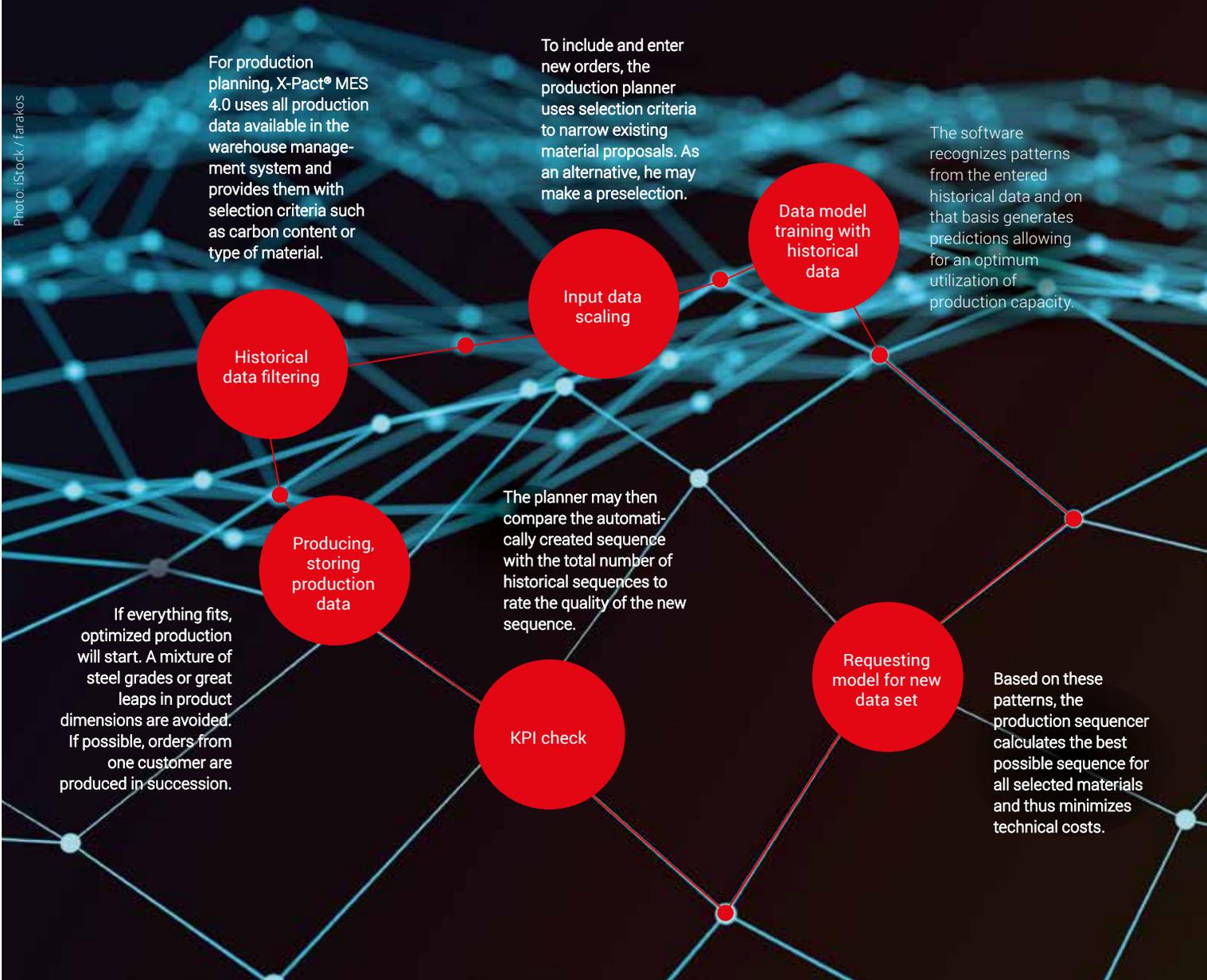
As regards the starting parameters (casting speed, furnace exit temperature, strip thickness downstream the last mill stand), a significant relation to the temperature deviation could not be found.

With the X-Pact® Performance Enrichment Analysis, a method using artificial intelligence and developed by SMS group jointly with Jacobs University Bremen, it is possible to exactly prove the unexpected correlation between a defective work roll in a mill stand and the temperature deviations in the cooling system and that more clearly and effectively than with a standard analysis.



Scan the QR code to watch a video on the topic and on possible applications of artificial intelligence in steelworks.

Photo: iStock / Farukos



Data model application cycle.

The analysis of the roll IDs revealed a high number of coils with major deviations between nominal and actual temperature when an ID44 work roll was used or replaced during the last roll change.

With an active Performance Enrichment Analysis module, a large number of possible fault cases can be monitored simultaneously. X-Pact® Performance Enrichment Analysis consistently evaluates the data during ongoing operation and thus permits deviations in production to be quickly recognized and reported on.

X-Pact® Business Intelligence automatically generates reports to the persons in charge in order to further investigate the faults, if necessary, and finally to remedy them.

Prediction of completion date of customer orders

The X-Pact® MES 4.0 production planning system receives an order from the customer's ERP system. Such an order contains information on the essential properties of the strips to be produced, for instance on the output weight and the respective target date. ▶

X-PACT® MES 4.0

The production planning system uses the customer order data to prepare an optimum production schedule. In addition to the capacities of the different production units, it considers orders that have already been scheduled as well as miscellaneous technical conditions. The aim is to produce all ordered strips and dispatch them to the customer "just in time".

X-Pact® MES 4.0 prepares an optimal production schedule for the requested strips considering the capacities of the production units involved, scheduled orders as well as miscellaneous technical conditions.

In this context, extremely precise planning is of crucial importance to make sure all strips are produced "just in time" and can be dispatched to the customers shortly thereafter. Any delays in strip production affect the whole downstream logistics. Cargo ships or freight vessels do not wait for strips that are not ready for shipment in time. However, if the strips are produced ahead of time, they will block storage capacities. The consequences are high amounts of tied-up capital and high storage costs as well as obstructions in the subsequent production process.

If a data-driven approach is used to calculate the completion date of the customer order this will require a data history according to which the planned order times can be compared to the times actually needed by the individual production lines for each of the products. So, it is possible to learn from completed orders and to adapt future planning in such a way that the difference between planned and actually needed time will decrease.

Automatic sequencing

In the X-Pact® MES 4.0 system of SMS group the Production Sequencer takes over short-term planning on the material level for a few days and

optimizes the sequence of material handling at the respective plant units to keep technical costs to a minimum. Prior to determining a production sequence, the operator has to select those orders from the pool of open customer orders that are to be produced at the plant. In X-Pact® MES 4.0, all products to be produced for the same customer order have identical planned properties.

X-Pact® MES 4.0 supports the planner also in his material selection with the system considering the historical sequences stored in the X-Pact® Warehouse Management system. From these data, X-Pact® MES 4.0 learns to automate the grouping of materials for a sequence. To narrow material proposals, the planner may apply a selection criterion for a group. As an alternative, he may preselect the materials for the new sequence and have the Production Sequencer select those materials that optimally match the preselected ones. The Production Sequencer module uses a trained data model to recognize patterns in the historical sequences and to copy the behavior from the past.

The Production Sequencer then calculates the optimum sequence for all materials selected and minimizes technical costs aided by the so-called "Travelling-Salesman-Problem" solution.

To receive an objective measurement for all sequences and to be able to compare them, the system calculates the costs of the respective sequences using an additional cost evaluation function. Thus, the planner will be able to compare the new sequence to the total number of historical sequences to rate its quality.

For this purpose, the costs involved in the respective sequence are normalized. If the costs are calculated by the cost evaluation function, miscellaneous technical aspects will be considered. These may be strip material dimensions (thickness, width, etc.), prevention of dimensional leaps or steel grade changes from one coil to the next. Since the Production Sequencer learns from the past and automatically proposes materials to the planner, it substantially cuts the costs in coil production processes compared to conventional production planning systems.

Prediction of throughput and yield

Looking at the process times of the individual CSP® equipment, it is the prediction of the caster throughput that has major influence on the prediction of the overall process time of a CSP® plant. Here, throughput is a measure of material weight per time unit.

If the throughput is to be predicted by an analytical model, it is indispensable to know the dependencies and relationships between

parameters with reference to throughput, whereas the data-driven approach characterizes the technical behavior through learning from historical data without having any technical knowledge.

With a trained model, as for example a neural network, categorial as well as numeric variables can be taken into account. It is also possible here to consider parameters with unknown influence. The user does not have to ▶

Tailor-made
production
processes reduce
storage costs.



examine the dependencies of all parameters himself. All that has to be done is to collect, filter and normalize historical data, evaluate the difference between target and actual values, train the different machine learning models, and finally use the model that best predicts the expected values for a new set of parameters.

An examination of historical data with the performance of the continuous caster analytically calculated on the basis of the slab width revealed a large number of major deviations between predicted and actual performance. After a data model had been trained using the same customer data as test data, the number of major deviations between predicted and expected performance values was considerably lower. Against this background it can be assumed that performance calculation using the data-based approach permits a much better prediction of the actual performance.

The applications presented above for different prediction methods, proposal systems as well as for early detection of anomalies in production demonstrate how machine learning helps improve processes in the steel industry in terms of quality and quantity. These applications are just some of the large volume of improvements that can be achieved with the aid of machine learning methods. Using data-driven methods is simpler than implementing analytical models that are often very complex and can be advanced only by the engineers themselves. As a Leading Partner in the World of Metals, SMS group is taking advantage of the great opportunity provided by machine learning and artificial intelligence. ♦



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AT A GLANCE

The individual modules of X-Pact® MES 4.0 support the customers of SMS group in planning and controlling their production processes. In order to provide smart and most precise assistance, the system makes active use of artificial intelligence already now.



Extended AI components in X-Pact® MES 4.0 modules.

X-PACT® PERFORMANCE ENRICHMENT ANALYSIS

The method monitors possible interferences and faults in ongoing production and automatically shows correlations between several input parameters.

- Simultaneous monitoring of all possible faults
- Continuous evaluation in ongoing production
- Fast recognition and reporting of deviations in the production process

X-PACT® BUSINESS INTELLIGENCE

Whenever a malfunction is recognized, the Business Intelligence module automatically generates a report for the operators in charge who may then carry out further examinations and eliminate the problem, if required.

- Automatic reporting
- Involving staff in solution finding
- Fast remedy of malfunctions

PRODUCTION SEQUENCER

The Production Sequencer in the X-Pact® MES 4.0 system serves for short-term production and material planning. To keep technical costs as low as possible, it optimizes the sequence of material handling in the individual plant units.

- Automated support in preparing the best possible production sequence
- A cost evaluation function considers technical aspects and allows for reliable comparison

INTERVIEW

EXPERIENCING DIGITALIZATION

What values really matter.

Dr. Reifferscheid, what can experts from all over the world look forward to seeing during their visit to the SMS group booth at the METEC trade show?

At the SMS group booth, visitors to the fair will experience the future of the learning steel mill, in other words of a digital eco-system. No visions, but hands-on solutions that already today create added value for the plant operators. We show how we use digitalization to improve processes on a permanent basis. Our aim - to the benefit of our customers - is to achieve a steel mill that operates at maximum profit. At the SMS group trade fair booth, we can explain in personal dialogs what is feasible. As the "Leading partner in the World of Metals", we present an exhaustive picture of what digitalization means for our industry.

How important are personal contacts in the digitalization age?

Personal contacts are essential. Digitalization is a service-oriented business, which will prosper only if done close to or together with the customer. We are partners to the experts at our customers' works and we implement the projects in concert with them. In so doing we start out from very different requirements and conditions. We tailor our approach to the customer's individual situation and necessities, and remove doubts or concerns, if any, about what challenges digitalization may bring.

What should the trade show visitors take a look at on the SMS group booth?

Well, actually, they should see everything. But those particularly interested in digitalization should talk to me or my colleagues, and we will be happy to show them around and talk about the four central topics that characterize the learning steel mill. There will be interactive desks informing about how we go about plant condition monitoring, production planning, product quality and the platform that brings all these spheres together. All these topics are very closely interlinked. Digitalization establishes itself as an eco-system that integrates everything. It is all about finding answers to one very complex question: How can I relate product quality to the condition of the plant, to production control and to production planning? What options does the platform provide to interlink these various functions and correlate them with one another? We will present the visitor a solution, and we look forward to discussing that solution with him.

Is the trade fair also about getting feedback?

Yes, it is because digitalization absolutely needs mutual exchange. It is not a one-way street. What we present at the trade fair is one possible outlook, one target scenario of where we think the journey of digitalization will take us. The way to that scenario will be different in each individual case. And we will have to consider

USE CASE

A Use Case describes an existing or planned system from the user's perspective by means of simple models. A Use Case provides understanding of how the actor and the system interact. Each Use Case should go with a User Story which maps the monetary value of the application. The valuation should be objective, assessable and negotiable. The User Story should be triable at small scale.



Dr. Markus Reifferscheid, Vice President Research & Development at SMS group and Managing Director of SMS digital GmbH, describes in this interview why a visit to the SMS group booth at METEC 2019 is definitely worthwhile. He explains the benefits and advantages of digitalization for the plant operators and tells what differences there are between SMS group and digital providers.

SMS digital

step would still leverage enough value in the specific use case. Only if that is for certain will we proceed. As a full-liner, we look at the complete process chain. We can improve the melt-shop, the continuous casting plant, the rolling mill, the annealing line, the galvanizing line and all other plants of the supply chain through digitalization, because we have the necessary technological know-how and expertise.

Is SMS group a trailblazer in the digitalization market?

This question cannot be answered in one sentence. We have been active in the field of digitalization for many years, long before the term has become a buzzword. And yes, I think that we hold a leading position when you look at the customer value our implementations leverage. Additionally we have many promising proofs of concept in the pipeline. Whether they will be implemented will depend on the success potential for the customer and the customer's specific requirements. This is another great strength of ours. We have the know-how to assess the benefit for the customer. We can provide him comprehensive advice as to how to tackle digitalization. Therefore our consulting service is extremely helpful already in the forefront. Thus the customer can focus on those use cases that will be most profitable for him. In this way, he benefits from our longstanding experience and from our products, about which we can say: They create provable added value. ▶

whether that target scenario really provides every customer the full scope of added value. Therefore we must tackle the issue by exchanging ideas at eye level as partners. However, when discussing digitalization issues, one may run the risk of getting lost in visions. Out of excitement, one may easily say: "That's what I need!" It is often only afterwards that the vision turns out not to have been the right choice. SMS group takes a different approach here. Digitalization is not an end in itself. Instead, its focus should be value creation. Digitalization is a process which we agilely plan and implement step by step and in cooperation with the customer. Before we take the next development step, we always ask ourselves whether that next

Could you please describe in more detail the consulting service provided by SMS group?

We have two basic consulting offers: Digital Awareness and Digital Fact Finding. We take a look at the customer's works together with the customer to get an idea of the prevailing level of digitalization and of what is feasible. We develop the use cases in concert with the customer, followed by an evaluation. We also offer training courses and workshops for the customer to acquire useful know-how and become well prepared for the digital transformation. And, once the consulting phase has been completed, we can provide the complete implementation from a single source. Additionally, we maintain close contacts with start-ups. This makes us a competent partner when it comes to taking start-ups on board.

Does digitalization always have to be a big, all-encompassing undertaking?

No, the rule is to "think big and start small". We offer a wide and diversified range of small digital solutions and products. While the learning steelworks being the ultimate target of the development, it is often overlooked that small solutions can also provide considerable financial value. Dozens of our references attest to the fact that small modifications that do not involve a great effort provide lucrative results, too. We have some 150 solutions that are ready to be implemented right away.

Where does digitalization begin for the plant operators?

The basis is always well functioning plant equipment and a modern automation package that controls the process. This is the starting point for digitalization. When this is there to start with, one can think beyond the situation on hand and look for ways of how to generate additional value by further advancing the existing structure. Another good thing about digitalization is that it does away with the silo mentality, in other words, thinking is no longer confined to the limits of the meltshop, the casting plant, the rolling mill and so on. Digitalization is in constant search for optimization potential in issues of more general scope and in the interrelationship between all processes and plants.



"At the trade fair, we will present an all-encompassing picture of what digitalization means for our industry."

What has SMS group that digital providers don't have?

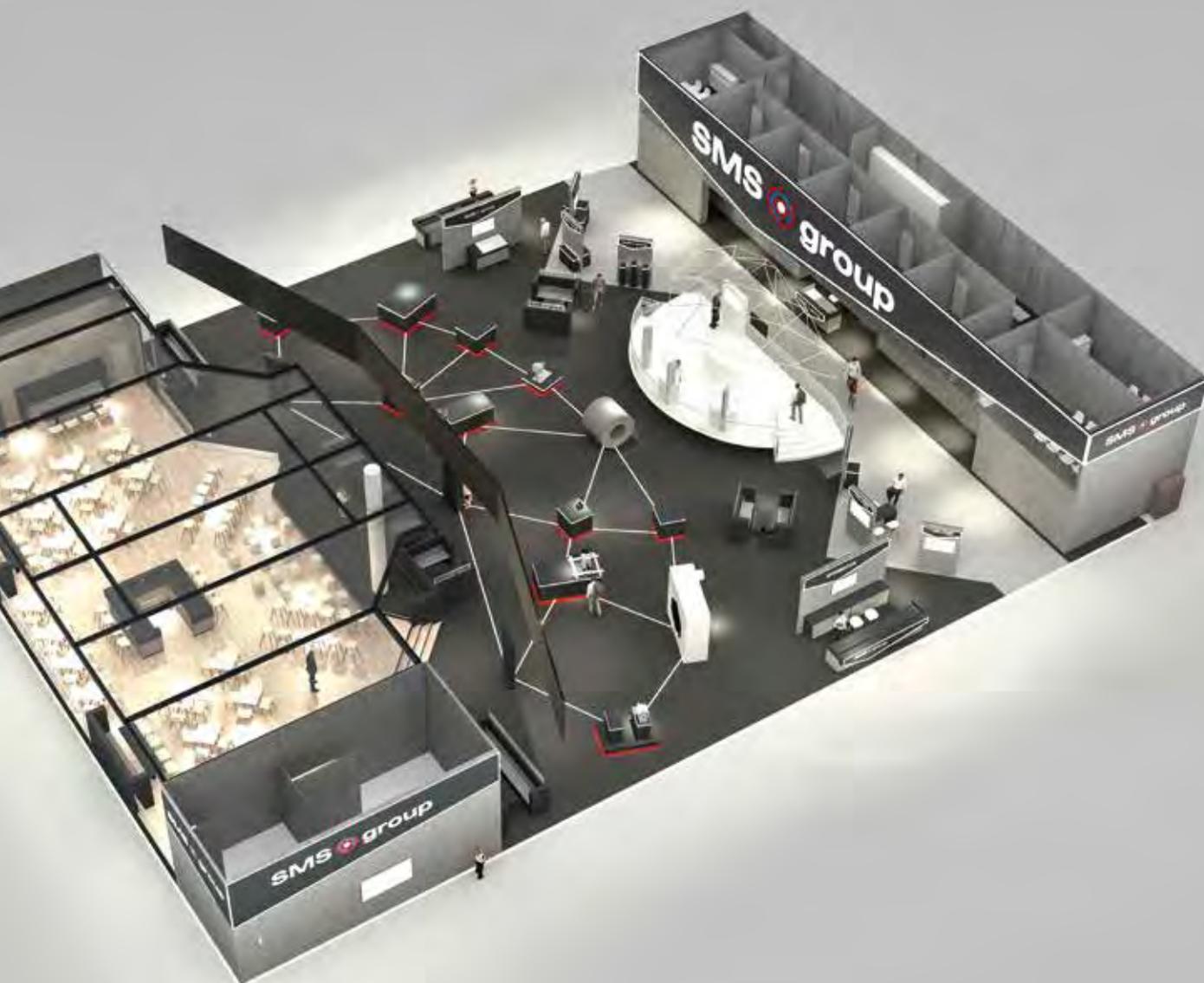
A key aspect of digitalization is that it generates value from data. This only works if I know what kind of data I need to achieve this. Who could be in a better position to understand the data than the plant builder and the plant operator? We know what equipment to monitor and how to monitor process models - because we have developed both. And we can assess the process technology down to the last detail because more often than not it is from us. No digital provider can offer something like this. Therefore, the customer will get much more from SMS group than he would get from any digital provider.

Are you saying that in the plant and mechanical engineering area digital providers reach their limits?

Digital providers or AI companies are good at analyzing data. However, in many cases this is not enough. Often they are not in a position to really understand whether the problem they want solve really originates from the sets of data under examination. Instead, they have to rely on the customer to make the judgment. They are provided with data, but they are often not able to interpret it with sufficient scrutiny. Or they may even not be able to tell what data is missing and whether and how that data can be made available. Instead, the customer needs a partner who can do all this.



METEC, the international trade fair for metallurgy, continuous casting and steelmaking, is the meeting point for leading industry experts from all over the world.



Does this mean SMS group has all the competences necessary to implement the digitalization process at the customer's facilities?

We adopt a multi-disciplinary approach. This means our customers can talk to a team of multi-disciplinary experts, including data integrators and technology integrators. We have both, digitalization experts and specialists who understand the processes and can input their profound process know-how. Digital providers, by contrast, have to look around elsewhere for such in-depth know-how. When we provide the process model, we are the only ones to understand the model in all its details. We are going to expand our own artificial intelligence competence within our disciplines. These are very special AI competences as we can bring to bear our

domain knowledge. I would call this "industrial AI". Actively entering into a dialog with the customer's operating personnel, process engineers and maintenance staff, and developing solution proposals in a joint effort is our strength.

And for this, METEC is the right place?

It is the best place to meet technical experts from all areas and disciplines. Also our accompanying program including Leading Partner Talks will provide numerous exciting inspirations. I look forward to many talks about digitalization. ♦

 **Markus Reifferscheid**
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Heavy-plate heat treatment line with MultiFlex-Quench® in the foreground.

GERMANY

KEEPING AN EYE ON RENEWAL

SMS group contributes to ESTAD with a great number of technical presentations.

Flat rolling mills are extremely durable production facilities operated over many decades. The production of flat products, however, faces consistently varying requirements, especially with a view to efficiency, product quality and product portfolio. Therefore, rolling mills and the pertaining equipment must be adaptable. As Leading Partner in the World of Metals, SMS group offers custom-tailored technological upgrades for plants at all stages of their life cycle. Catching up with the era of digitalization is no challenge, not even for aged

PAPERS

A list of all papers presented by SMS group at ESTAD is available at:
www.sms-group.com/metec

plants. Also, there is a wide range of options for mechanical renewal.

Within the scope of this year's European Steel Technology and Application Days, ESTAD for short, which will be held in Düsseldorf from June 24 to 28, SMS group is going to present the latest integrated technological modules and comprehensive solutions for hot and cold rolling mills. Most of the examples and technologies to be presented are available for both existing and new facilities. ♦

**Contact**www.sms-group.com/metec

WORLDWIDE

MULTIFLEX-QUENCH® IN PLATE COOLING PROCESSES

In heavy-plate heat treatment lines, the MultiFlex-Quench® offers flexible cooling strategies. SMS group presents these innovative strategies at ESTAD.

Under the name MultiFlex-Quench® SMS group introduced to the market a new technology for the cooling of plates in heat treatment plants. Flexible cooling strategies permit standard and special materials as well as newly developed materials with high quality requirements to be produced.

In 2016 already, the new MultiFlex-Quench® in the works of Acroni in Jesenice, Slovenia, produced the first tempered plate. To this customer SMS group had supplied a completely new heat treatment line for an annual production of 80,000 tons of heavy plate. At the beginning of 2020, the new heat treatment line of Ilsenburger Grobblech GmbH, a subsidiary of Salzgitter Group, will start to operate. The ca-

capacity of this line will be more than 200,000 tons per year. The MultiFlex-Quench® will then be operating in the two most advanced heavy-plate heat treatment facilities.

QUALITY FOR DEMANDING APPLICATIONS

The plates produced are used for highly stressed steel structures such as mobile cranes, in the vehicle construction sector and for building pressure vessels and pressure pipes. Another field of application are wear-resistant steels as used in the steel industry, for mining machines and in cement plants.



MultiFlex-Quench®.

At the same time, these applications push the advancement of steels as they have to combine increasing strength with excellent ductility and good weldability with perfect flatness.

One prerequisite for the production of state-of-the-art heat-treated plates is that all process parameters can be flexibly set, from austenitization to targeted cooling at optimized cooling speeds and further to adapted tempering temperatures. Only if all process stages are perfectly harmonized, will it be possible to tap the full potential of the material steel that is in demand worldwide.

The paper presented at ESTAD considers different aspects of the new technology for plate cooling, including the

development of the new cooling technology, numerous options of flexible cooling, model and process development as well as operation results from and experience with the pilot plant. ♦

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INTERVIEW

VIBRATIONS UNDER CONTROL

Dr. Matthias Krüger and Sebastian Richard, Research & Development of SMS group, explain means and methods to eliminate undesired vibrations in cold rolling processes.

Dr. Krüger, why do vibrations in cold rolling mills present problems?

Dr. Matthias Krüger: Cold-rolling of steel or aluminium, especially in multi-stand mills and at high speeds, is accompanied by different types of vibration. They are extremely critical since they may impair the quality of the rolled strip. In addition, certain modes of vibration can only be compensated by lowering the rolling speed, which in turn has a detrimental effect on mill productivity.

Would you please briefly describe these vibration problems to our readers?

Dr. Matthias Krüger: Yes, of course. According to our experience, there are two particularly critical vibration modes which we call 3rd-octave chatter and 5th-octave chatter. The frequency range of the 3rd-octave chatter is between 100 and 160 Hz while for the 5th-octave chatter it is more than 440 Hz. The term 5th-octave chatter comprises numerous modes of roll set vibrations that may lead to shape defects of the cold strip. These vibration modes are mainly due to external causes, for example defects in gear units or bearings. But this offers the advantage that they can be prevented.

3rd-octave chatter is a different mode of vibration. It is self-excited. As a consequence of an instable process the top rolls vibrate against the bottom rolls, which causes thickness fluctuations in the cold strip. If no corrective measures are taken, these fluctuations will increase and may finally lead to strip breakage. This phenomenon can mainly be watched in the last stands of a tandem mill and at high rolling speeds. To date, the counteraction most frequently taken has been a reduction in rolling speed in order to prevent strip breakage.

You and your team in Research & Development have got a grip on this vibration issue. The keyword here is “active vibration damping”. Mr. Richard, you are involved in the project, too. Would you please give our readers an idea of what “active vibration damping” is?

Sebastian Richard: When we regard active vibration damping, we initially focus on the above mentioned 3rd-octave chatter. The core component in active vibration damping is the so-called Anti-Chatter Device (ACD) that we designed and created within the scope of a development project. It is an actuator with ▶

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piezo elements installed in an actuator box. The system generates a precise counter vibration to the undesired vibration and eliminates it. This method we call active vibration damping.

How is the counter vibration generated? Or, to put it differently: What are the essential components of the active vibration damping system?

Sebastian Richard: In addition to the ACD, sensors are needed to measure the vibrations, plus a control system to precisely generate the counter vibration. This control system calculates the required counter vibration for the ACD to generate it by moving the piezo elements. For installation of the ACD, we use the area in the mill stand between bottom backup roll and wedge adjustment system.

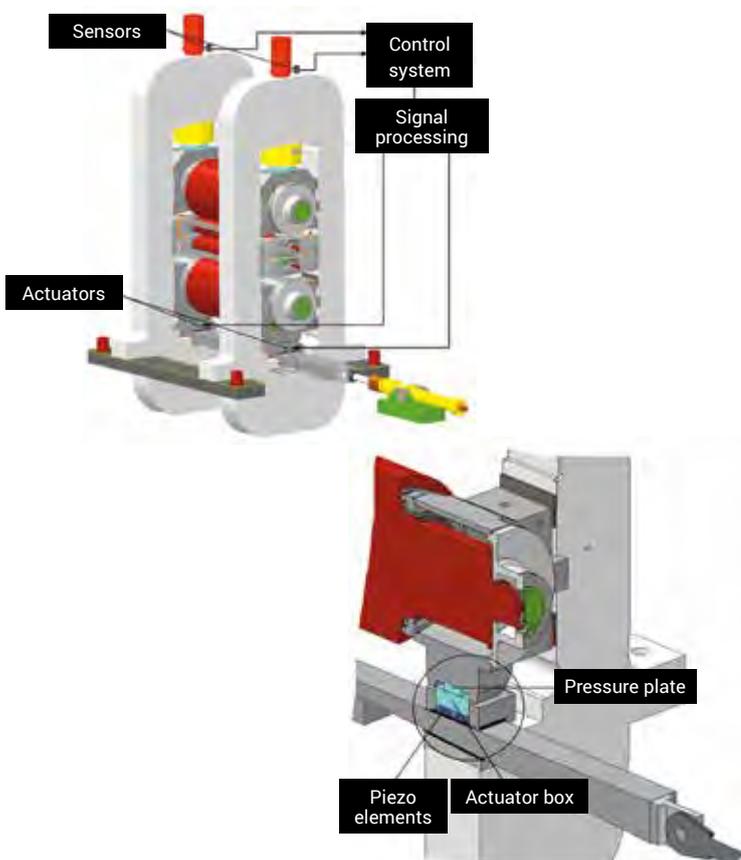
Do you have experience from using the active damping technology, respectively the ACD, in operation?

Sebastian Richard: In 2017, we first installed an ACD in a four-stand aluminium tandem cold mill. The operation results showed clearly reduced acceleration amplitudes in the frequency range of 3rd-octave chatter with the active vibration damping unit switched on.

What does this mean in concrete terms?

Dr. Matthias Krüger: In concrete terms this means that the system installed in the pilot plant confirmed the general functioning of the piezo elements installed in the ACD and of the implemented control system. After minor optimization of the control system we could also prove that rolling was possible at higher speed than before the installation. This means, the former restriction in rolling speed due to 3rd-octave chatter has been overcome, a fact that substantially improves plant productivity. Now, that the mechanical design was optimized, this system has been in continuous operation in the pilot plant since April 2018 to gain long-term experience for other plants, too.

Position of Anti-Chatter Device (ACD) in the mill stand



Is the active damping technology available for new facilities only?

Sebastian Richard: No, it isn't. It can also be retrofitted in existing, multi-stand cold rolling mills for steel and aluminium, after design and plant-specific boundary conditions have been checked. Beside an increase in productivity due to higher rolling speeds, the customer will benefit from further advantages such as prevention of strip breakage or longer lifetime of mechanical components due to lower vibration levels.

In the context of vibrations in cold rolling mills, do you see other options, apart from active vibration damping, to effectively counteract vibrations?

Dr. Matthias Krüger: We think chatter management is a reasonable concept for plant users, and also for plant manufacturers, to counteract vibrations in cold rolling mills. We comprehend chatter management as a holistic concept comprising various aspects from plant design up to cold mill operation. Our aim is to completely prevent vibrations or keep them down to an ac-



Actuator box during a test in the SMS group Hilchenbach workshop.

ceptable level. With regard to plant design, this concerns in particular the low-vibration design of components or the integration of vibration-damping means or measures such as the ACD we described above.

How important is the topic of maintenance in this environment?

Dr. Matthias Krüger: The operation of cold rolling mills requires special attention to be paid to the topic of maintenance, since timely servicing or replacement of components can prevent undesired high vibration levels. What really helps here is the use of a vibration monitoring system like the Genius CM® Chatter plus of SMS group. It supports cold rolling mill operators in identifying and monitoring different vibrations and their origins. In addition, the unit can be linked to the X-Pact® level-1 automation system which, especially in plants operating without the active damping technology, is able to decelerate the facility much faster than the operator can do and thus prevent strip breakage by detecting 3rd-octave chatter at an early stage. ♦



ACD installed in the pilot plant.



Dr. Matthias Krüger

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State-of-the-art hot strip coiler in the exit section of a hot strip mill. In the case of hot strip coils made from high-strength steel grades, safe transportation from the coiler to the strapping machine can, under certain circumstances, prove to be quite a challenge.

WORLDWIDE

GOING FOR SAFETY

In hot strip production lines, coils can be easily and reliably secured with the aid of different technical solutions.

The demand for high-strength hot strip grades for use in manifold industrial applications is on the rise. To process these kinds of steel, specific technical requirements in terms of rolling and processing have to be met. This includes safe strip coiling at the hot strip coiler as well as safe coil transport to the downstream stations.

Depending on the yield strength and the strip thickness, a coil has residual stresses that may cause it to spring open. Moreover, an instable coil may roll off the coil transfer car. To make sure the rolled, high-strength coils can safely be handled, SMS group offers custom-tailored technical solutions which are easy to integrate into hot strip mills, including existing and older ones, and which offer maximum safety for both the process and the operators involved. As a rule, a dis-

inction is to be drawn between two major requirements: on the one hand it is temporary securing of the steel coils during removal from the coiler, and on the other permanent self-securing of the coil due to targeted plastic deformation of the final wraps in the hot strip coiler combined with a significant reduction in the remaining bending moment. The aim must be to safely transport the coil to the strapping machine to further secure the coil.

Technical solutions for permanent securing (1)

Before winding, the strip head is mechanically pre-bent to a smaller diameter by a three-roller bending device. In the coiled strip, the bending moment is reduced to make the outer wrap rest against the coil without stress or spring effect.

In addition to the mechanical influence on the strip, there may also be a thermal influence. For this purpose, the coiler is equipped with additional cooling devices that are activated for special material grades. One-sided cooling of the strip generates a temperature stratification. The strip is then coiled with this temperature profile. Once coiling has been completed, temperature equalization takes place. Due to the thermal expansion in the coiler, the strip suffers local deformation. This expansion may counteract the strip spring effect and even completely eliminate it.

Technical solutions for temporary securing Stabilization on the coil car

In order to stabilize coils on the coil stripper car, a hydraulically operated pivoting arm can be installed in the lifting table. This arm is positioned at the entry-end contact area of the coil, thus providing additional support and a secure base for the coil to be taken away. One advantage of this solution is that the coiler design does not require any major adjustments.

Coil clamping from above (2)

With this coil stripper car design, the supporting area is not enlarged. Instead, the coil is clamped at three points around the circumference to prevent the coil from springing open. For that purpose, a hydraulically operated hold-down device is fitted at the operator side of the coil stripper car for clamping the coil from above.

Clamping in the coil eye (3)

The system of clamping in the coil eye is a component of the discharge system for thick strip and high-strength materials. It generally consists of a coil stripper car with pivoting arm, a hold-down device, and an additional holding arm in the coil eye. Depending on the customer's specification, a movable coil deposit in the area of the coil strapping machine may also be required.

The holding arm gripping the coil's eye is usually attached to a coil car positioned downstream of the coil stripper car in front of the coiler. The holding arm can be of fixed or movable design to be used in an existing coiler with unfavorable structural conditions. This holding arm in the coil eye ensures that the unstrapped coil is always clamped at a minimum of three points from finish-winding right through to strapping.

Conclusion and outlook

Due to the close spacing of the coil rollers (supporting rollers) on the standard coil stripper car, it is necessary for critical coils to implement the above measures either fully or in part.



1
Loading of a pinch roll unit with bending devices after workshop assembly.



2
Technical implementation for the production of special materials with low coil weights.

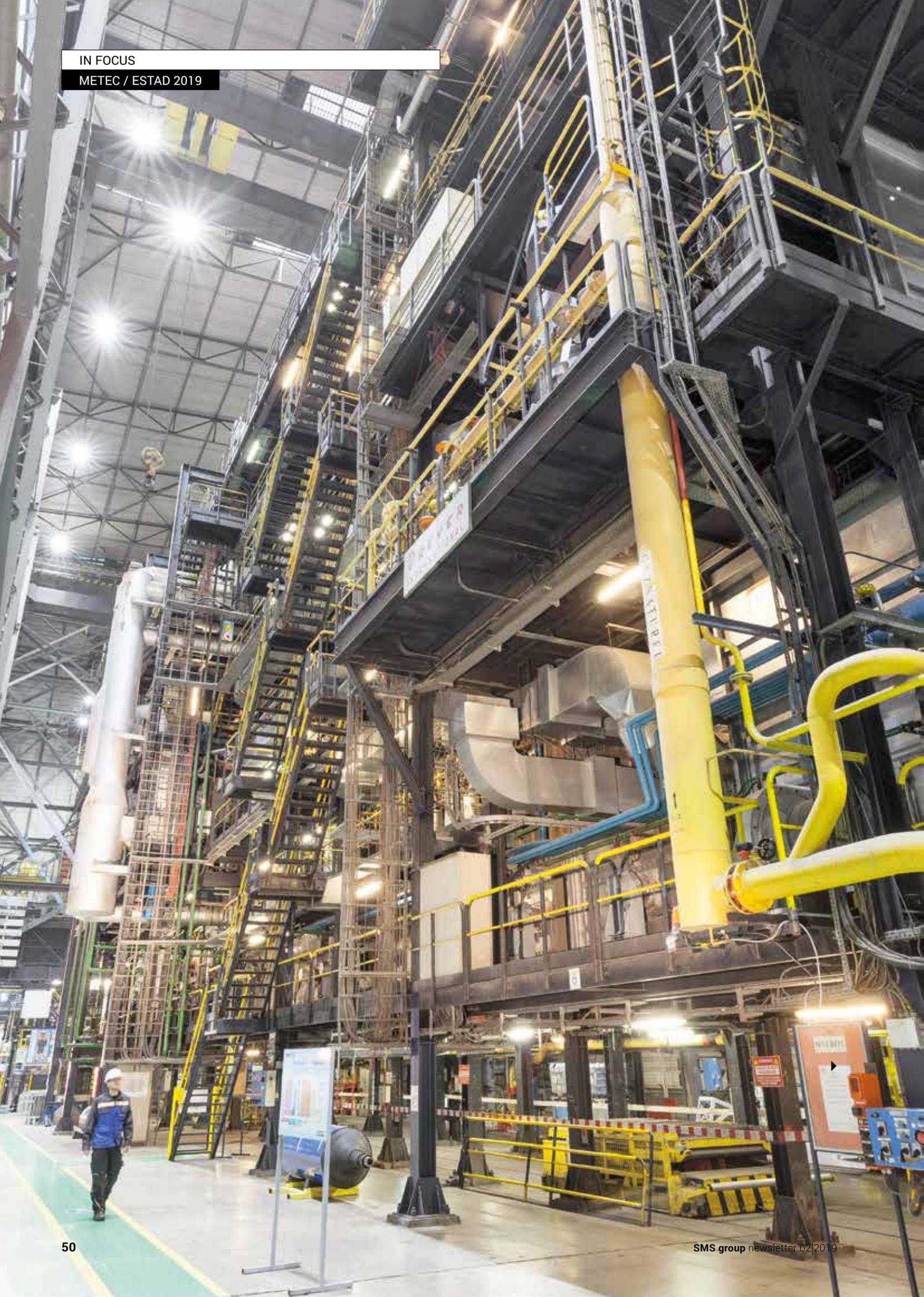


3
Clamping in the coil eye.

To avoid the use of this additional equipment, it is also possible to increase the supporting width for the coil leaving the coiler by means of a pallet directly conveying the coil out of the coiler without the need for any intermediate equipment. For new plants and major modification projects in particular, this solution offers distinctly more safety than the conventional stripper car method and can be implemented at moderate investment cost. ♦



Ulrich Cramer
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WORLDWIDE

X-CAP – THE X-RAY CONTROLLED ANNEALING PROCESS

Newly developed closed-loop control of the AHSS annealing process via X-ray phase fraction measurement completes the Intelligent Furnace (I-Furnace) concept.

- **The Intelligent Furnace (I-Furnace) concept** combines smart tools to optimize the heat treatment and the production process.
- **With X-CAP, the annealing process** can be precisely controlled. X-rays measure the steel structure and permit the mechanical properties to be adapted.

The production of modern AHSS (Advanced High Strength Steel) grades places high demands on the thermal process in annealing and hot-dip galvanizing lines. In particular, the automotive industry requires homogeneous properties of the steel strips not only over the entire length of the coils, but also from coil to coil.

In order to achieve this, information on the steel structure is necessary to control the process and compensate possible deviations caused in the upstream processes. Therefore,

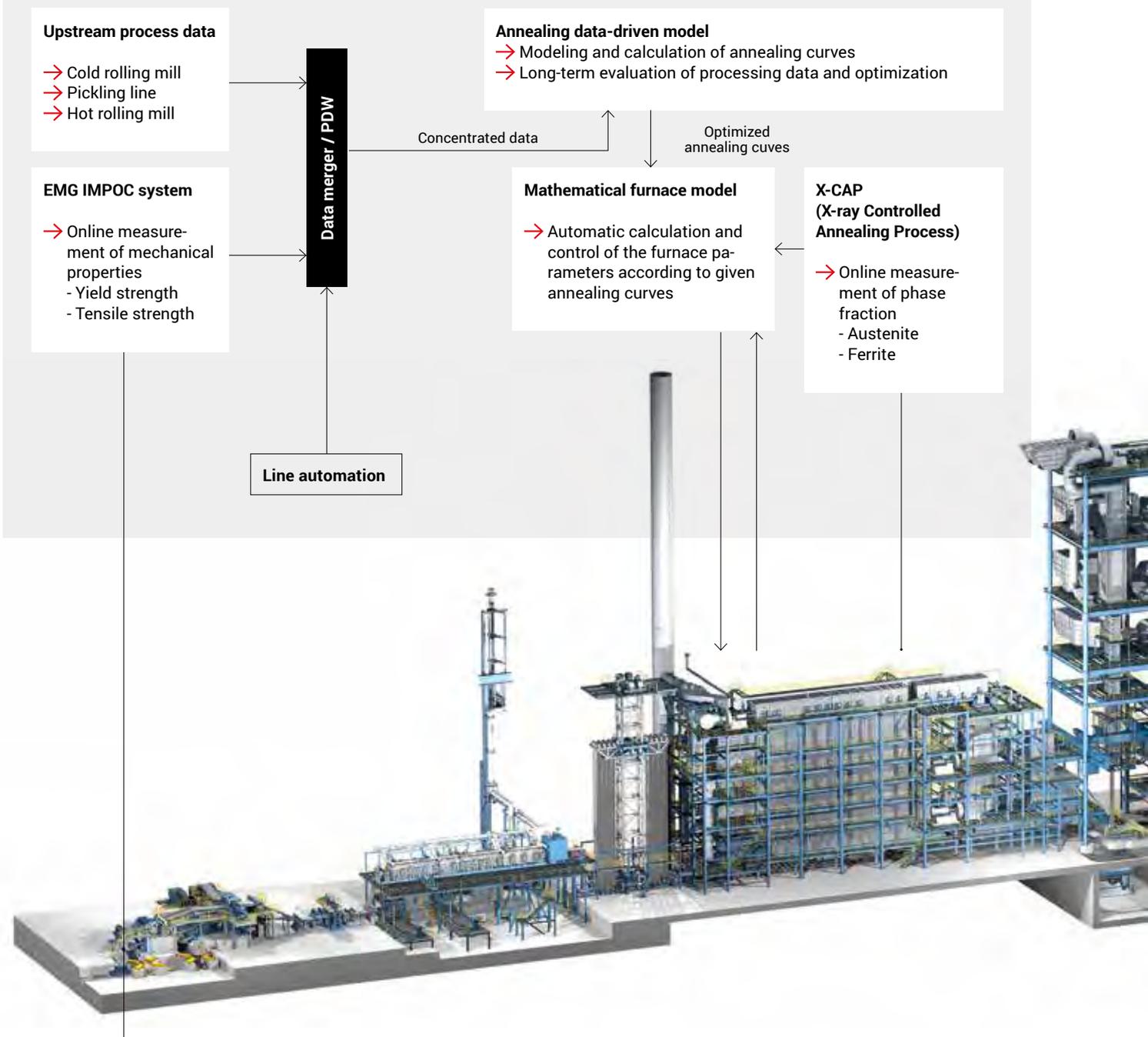
SMS group developed the I-Furnace including a smart annealing process and a production optimization model. Here, the combination of various tools leads to an optimized heat treatment and production process. Furnace control, online strength measurement and a model to predict the material properties after annealing are combined and linked. However, a closed-loop control of the process is not possible with a measurement system in the exit section of the line, far behind the process, because at that point the material already has its final mechanical properties. Thus, a further measurement system including control model has been developed in addition to the already existing tools to complete the furnace.

SMS group, Drever International and IMS Messsysteme jointly developed X-CAP (X-ray Controlled Annealing Process) permitting the steel structure to be measured within the annealing process and hence the mechanical properties to be controlled in the very process step where they are really determined. ►

X-CAP was first installed and successfully tested in the hot-dip galvanizing line at SEGAL, a subsidiary of Tata Steel, in Liège, Belgium.

OPERATING PRINCIPLE OF THE I-FURNACE CONCEPT

SMS group's I-Furnace has been completed by the new X-CAP system developed in cooperation with IMS Messsysteme and Drever International.



SECONDARY PHASE DETERMINES STRENGTH

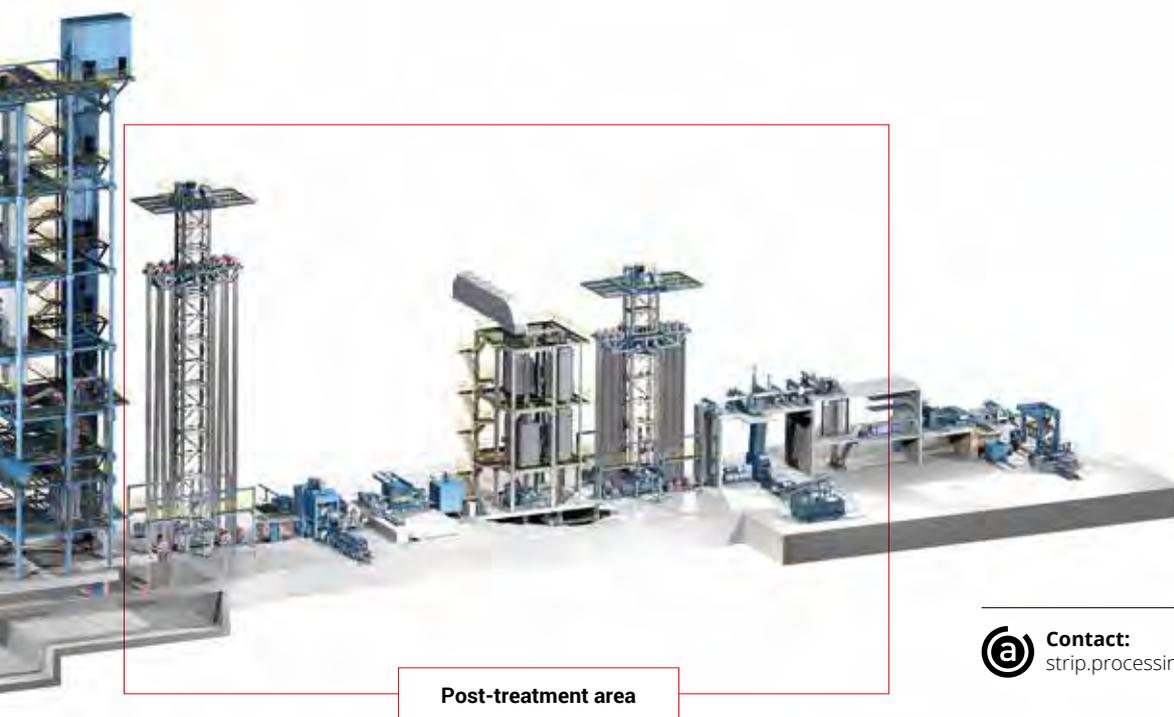
Finished AHSS grades consist of a combination of two or more phases to achieve the required material properties. During the heat treatment, the fraction of austenite before rapid cooling determines the amount of the secondary hard phases formed in the subsequent cooling stages. For AHSS, the secondary phase fraction is the main influence on the strength of the final product.

With X-CAP, a system is now available for the real-time quantification of the austenite content during the annealing process. The new on-line measuring system uses X-ray diffraction to define the crystalline phase fraction, and hence the austenite content, upstream of the rapid furnace cooling section. The continuous measurement of the austenite content in the furnace allows to directly compensate process and material changes, which otherwise would lead to product quality deviations.

IMPROVEMENT IN MATERIAL QUALITY

A first system was installed, inside a specially developed protective housing, in the furnace of a hot-dip galvanizing line at Tata Steel in Liège, Belgium, in the SEGAL plant in summer 2017. The measurement results were compared to the final product strength. Various tests proved that with using X-CAP it is possible to significantly improve material quality. X-CAP can save coils and keep the characteristic material properties within the required range, which even experienced operators are unable to do.

Producers of annealed and galvanized cold-rolled steel strips are facing several challenges when it comes to modern AHSS grades. With the I-Furnace and X-CAP, innovative solutions have been developed to improve and control the complex process of AHSS production. Further information on the recent development will be provided to visitors as part of a lecture at ESTAD or at the SMS group booth at METEC. ♦



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Quality



Industrie 4.0



Productivity



Efficiency



PERFORMANCE MODULES

Improving competitiveness with manageable investments.

SMS group is continuously developing a multitude of solutions to substantially improve the competitiveness of plants with manageable investments. These technologies, components, automation solutions and services are classified as performance modules. Each individual module helps customers improve the performance of their plants in one or several dimensions and hence achieve a competitive edge in a tough market environment. This means the modules will not only increase plant productivity and product quality, but also reduce operating costs and permit new, high-margin

products to be introduced. The Technical Service of SMS group also offers performance modules which are focused on digitalization. In an interview on Page 126 of this issue, Jochen Burg and Johannes Kahlen, Division Heads of Technical Service at SMS group, report on additional services. ◆



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Spare parts and logistics

Spare parts management within "mySMS-group" platform

Performance checkbox



Challenges

- Identification of spare parts by using a specific set of questions and a parts list software

Solution

- Platform enables online orders of spare parts with a high degree of transparency regarding lead time, delivery time and prices

Technical advantages

- Reduced internal process costs through an optimized interface management of business and technical competences

Efficiency

- Increase in effectiveness and efficiency through automation and transparency

Productivity

- Fast and easy identification of spare parts

Industrie 4.0

- Platform with equipment tree, spare parts lists and intelligent identification support tools



Upgrades and modernizations

IMMS® + Genius CM® + Support = Smart maintenance

Performance checkbox



Challenges

- Central platform which closes the gap between real plant data, plant-specific knowledge and maintenance management software
- Cost reduction by better exploration of parts' lifetime as well as reduction of unplanned down-times

Solution

- Use IMMS (especially the IMMS Data Package) as foundation and connect meaningful Process & Condition Monitoring (Genius CM®)
- Support by remote service or 24/7 hotline

Technical advantages

- Combination of OEM know-how, Condition and process evaluation with a close link to SMS expert team

Efficiency

- Make use of reliable data and support on demand

Productivity

- Make better use of the existing subsystems and possibilities

Industrie 4.0

- Basis of all Industrie 4.0 activities targeting the closing of the gap between machine and plant management



Bright steel lines

Automated drawing die adjustment
Reproducible quality

Performance checkbox



Challenges

- Straightness of raw material for a drawing line varies through the coil
- Visual control of the wire deflection behind the shear is required
- Reproducibility of the drawing die positioning parameters

Solution

- Closed-loop control circuit with measuring device for the wire position and automation of the die holder alignment

Technical advantages

- Reduced deflection of the wire before straightening
- Improved process transparency through measurement and visualization of target and actual wire rod position

Efficiency

- Workload of the machine operator is reduced due to automation
- Reduced waste material

Quality

- Reduced deflection of the wire rod before straightening

Industrie 4.0

- Automated closed loop control for quality improvement



Consulting & training

SMS TECademy

Performance checkbox



Challenges

- Worldwide reduction of personnel in metals industry leads to reduction of skill level

Solution

- Huge variety of training solutions from standard training program, tailor-made offers and web-based training programs. Training session started by skill assessment and closed by testimonial (if requested)

Technical advantages

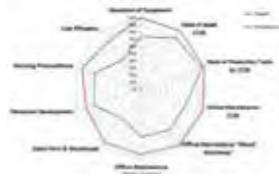
- Qualified in-house and external pool of trainers combined with training possibilities at cooperation partners (e.g. Tata Steel Europe)
- 1st class professional training facilities at SMS group available (TECademy, LernWerk, 3D Room...)

Efficiency / Productivity / Quality

- Steel production business is still and will be peoples business. The better the skills of the employees the higher is the chance of being best in class in steel business

Industrie 4.0

- Web-based trainings (webinars and webucation) as part of "mySMS-group"



Consulting & training

Consulting

Performance checkbox



Challenges

- Competition in steel industry is high. Overcapacities are enormous. One possibility: to bring the plant level to the maximum

Solution

- Consulting services in all areas of steel production: production, maintenance and management processes
- Concepts of detailed and structured fact-finding audits and consultancy work are in place

Technical advantages

- MET/Con, SMS group as well as allied partners recombine all areas of interest with centuries of practical experience
- A pool with more than 100 internal and 200 external experts is available

Efficiency / Productivity / Quality

- Giving an external view is often the door opener for reaching the next level of excellence

Industrie 4.0

- Consulting is part of "mySMS-group" platform



All plants



Smart Alarm Intelligent Maintenance Management System on the platform mySMSgroup

Performance checkbox



Challenges

- Relevant alarms get overlooked
- Inhomogeneous automation infrastructure leads to a lack of transparency
- Unused machine information

Solution

- Single source of truth for all machines
- Intelligent analysis and enrichment with additional information
- Innovative visualization

Technical advantages

- Be informed about relevant alarms immediately
- Continuous development keeps you up to date

Productivity

- Increase uptime
- Start predictive maintenance
- Preserve and share know-how

Industrie 4.0

- Connect all machines – independent of manufacturer and automation
- Access to web application – have machine health state available anytime, anywhere



GERMANY

MANAGEMENT TEAM EXPANDED

Changes to the Management
Board of SMS group GmbH.

To implement a clear functional orientation of the Management Board with focus on innovative products, efficient order execution and digital processes the Management Board of SMS group GmbH is expanded by two new colleagues.

Prof. Dr. Hans Ferkel – currently serving as Division Head of Technology and Innovation at thyssenkrupp Steel Europe AG – joins the Management Board as Chief Technology Officer (CTO) at the earliest possible date. Previously, Prof. Dr. Ferkel held executive management positions in research and development at Volkswagen.

Already since March 1, 2019, **Michael Rzepczyk** supplements the executive board of SMS group GmbH as Chief Operating Officer (COO). Previously, he was responsible for the Metallurgy Division of SMS group as Executive Vice President, mainly responsible for the execution of major projects.

In addition to Prof. Dr. Hans Ferkel and Michael Rzepczyk, the five-member executive team includes **Torsten Heising** (Finance) and **Prof. Dr. Katja Windt** (Digitalization), headed by longtime CEO **Burkhard Dahmen**.

“I am delighted to welcome Prof. Dr. Ferkel and Mr. Rzepczyk to our executive team”, said Burkhard Dahmen. “As experienced industry experts they will support SMS group in further expanding its market leadership in metallurgical plant engineering. The Management Board is now perfectly positioned to implement our growth strategy and to remain a key partner for our most sophisticated customers.”

With effect from February 28, 2019, **Dr. Guido Kleinschmidt** left the Management Board at his own request. In future, he will take on a new professional challenge outside SMS group GmbH. ♦



Contact:
www.sms-group.com

GERMANY

GERMAN DESIGN AWARD RECEIVED

On February 8, 2019, Axel Roßbach and Erdem Karakas, both engineers of SMS group, have solemnly received the German Design Award 2019 for their work in Frankfurt am Main. The award honors the development of a completely new design for spray heads employed for cooling dies in forging presses. Design and engineering as well as manufacturing type (3D printing) of the spray heads could only be enabled in this from by a holistic additive manufacturing approach. The awarding of the prize is evidence of the innovative power of SMS group.



Erdem Karakas (left) and Axel Roßbach received the German Design Award 2019.

 **Axel Roßbach**
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SMS group is involved in the development of steel materials.

GERMANY

FUNDED DEVELOPMENT PROJECTS

The European Union and the State of North Rhine-Westphalia support two development projects in which SMS group is involved. One project focuses on new steel materials for additive manufacturing (AddSteel). The objective is to systematically develop new function-adapted steel materials for additive manufacturing. In addition to the definition of steel alloys, the focal points are the adaptation and the optimization of SLM (Selected Laser Melting) process control and SLM plant technology for use in mechanical and plant engineering. For continuous mapping of the entire process chain the capability of demonstrators is tested and a cost-effectiveness analysis of the manufacturing process is carried out.

Another development project bears the title "Lightness.NRW". The objective is the development of a continuous process chain for manufacturing, processing and applying today's and future high-strength aluminium alloys in mass-produced lightweight automobiles of the future. The innovation focus is an interrelated development of a combination of material and process for hot forming of high-strength aluminium alloys to increase lightweight construction potentials. ♦



Contact:
www.efre.nrw.de
www.wirtschaft.nrw.de

RUSSIA

TECHNICAL UPGRADE UNDERWAY

With support by Paul Wurth, EVRAZ is upgrading a blast furnace at its steelworks in Nizhnij Tagil. The project is scheduled to be completed in 2020.

By October 2020, EVRAZ will have completed a technical upgrade of its No. 6 blast furnace at the integrated steelworks NTMK, located in Nizhnij Tagil in the Urals, Russia. The modernization will concern all systems of the existing installation and increase the blast furnace's nominal capacity by about 40 percent compared to the design of the previous campaign. With a hearth diameter of 9.8 meters and an

inner volume of 2,200 cubic meters, the new furnace will be able to produce 2.5 million tons of hot metal per year.

Paul Wurth will supply the following key technology to equip the furnace: a parallel-hopper-type Bell Less Top (BLT®) charging system, a complete top gas cleaning plant, copper staves for the high-temperature areas in the bosh, belly and lower stack, the complete hearth refractory lining with ceramic cup and machines for the cast house, all of which from TMT (Tapping Measuring Technology): fully hydraulic clay guns and tap hole drills for two tapholes, cover manipulators for the main run-



Skyline of the blast furnace facilities of NTMK showing blast furnaces 5, 6 and 7, and in the foreground the pulverized coal injection plant which was also supplied by Paul Wurth.

ners and hydraulic tilting runner drives. The technical solutions and the equipment are basically of the same type as those in use at NTMK's new No. 7 blast furnace in operation since February 2018. The Bell Less Top and the tapping machinery are going to replace competing systems, further consolidating Paul Wurth's and TMT's the leading market position for these technologies.

A SPECIAL ORDER FOR PAUL WURTH

In retrospect, it was precisely this – at that time brand-new – blast furnace No. 6 for NTMK, for which in 2003 Paul Wurth had been awarded the first order from Russia that was not related to top charging: an annular gap scrubber,

copper staves and cardan-type tuyere stocks. These systems had been in operation to the full satisfaction of the customer during a full blast furnace campaign lasting for almost 14 years, until EVRAZ stopped the furnace in spring 2018. Also blast furnace No. 5 has been operating with a similar equipment package from Paul Wurth/TMT since 2006. With the recent orders received for new equipment for blast furnace No. 6 at Nizhnij Tagil, Paul Wurth can claim for itself the position of a truly leading partner for EVRAZ in ironmaking technology and equipment. ♦

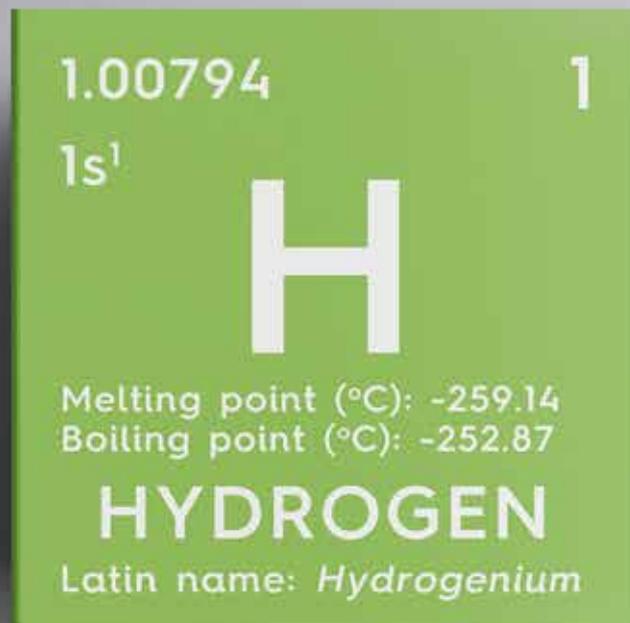


More information
www.paulwurth.com

WORLDWIDE

CLIMATE-NEUTRAL FUELS AND REDUCING AGENTS

Paul Wurth becomes new lead investor and technology partner of Sunfire.



Sunfire GmbH, developer and manufacturer of high-efficiency electrolysers and fuel cells, secured 25 million euros venture capital in a series C financing round. New lead investor is the Luxembourg-based technology provider Paul Wurth S.A., a company of SMS group.

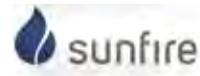
Thanks to the injection of fresh capital and with the support of Paul Wurth, Sunfire will implement as from 2019 commercial multi-megawatt projects applying high-temperature electrolysis and power-to-liquid technology. For Paul Wurth, this partnership means a significant step in view of new technological developments leading to green steelmaking as well as an opportunity to enter the growing e-fuels market.

The technologies developed by Sunfire allow producing climate-neutral fuels and gases for sectors which today can hardly do without fossil energy sources, such as heavy load transportation, aviation, steel industry or chemical industry. Green hydrogen is produced based on green electricity in an efficient high-temperature electrolyser, using waste heat generated for example by industrial processes.

In the latest product version, high-temperature electrolysis can not only reactivate water, but also CO₂ and thus transform, in the most direct way, combustion off-gases into clean feedstock, replacing fossil oil or natural gas. The produced hydrogen can be used directly or can be transformed in further process steps into the CO₂-neutral oil substitute e-Crude. In refineries, it can be further processed into e-gasoline, e-diesel and especially e-kerosene for aviation. Presently, Sunfire is building the first high-temperature electrolyser at megawatt scale.

SOLUTIONS FOR ENERGY TRANSITION

"Thanks to our so far largest financing round we pave the way for the industrialization of our technology validated in pilot plants. We experience daily how the interest for our solutions for energy transition is growing," says Carl Berninghausen, CEO of Sunfire. For example,



STEPS TOWARDS SUSTAINABILITY

Founded in 2010, Sunfire GmbH develops and produces high-temperature electrolysers (SOEC) and high-temperature fuel cells (SOFC). The company employs 130 people.

Salzgitter Flachstahl GmbH is counting on green hydrogen in a successful pilot project. "Therewith we have already set a signal in the steel sector. With Paul Wurth joining the venture, we become a valuable partner for energy intensive industries. This milestone means for us an important step towards an industrial company, and we will now be able to expand our pure product business to service activities also in the field of projects."

For Georges Rassel, CEO of Paul Wurth, "our collaboration with Sunfire clearly expresses our strategy to play a leading role in the upcoming transformation of the steel industry towards CO₂-free steel production. Paul Wurth designs and supplies complete blast furnace plants, coke oven plants as well as by-product treatment facilities for the primary stage of integrated steelmaking. We would like to accompany our customers also in their journey to hydrogen-based hot metal production and support them to achieve climate protection targets."

The existing Sunfire investors, INVEN Capital, Idinvest Partners, Total Energy Ventures and „Sunfire Entrepreneurs Club“, also participated in the new financing round. ♦



More information
www.paulwurth.com
www.sunfire.de

2015

Liberty
Speciality Steels
(formerly known
as Tata),
Stocksbridge,
UK, VIM plant.



GERMANY

PIONEERS WITH INNOVATIVE STRENGTH IN METALLURGY

SMS Mevac celebrates its 50th anniversary this year. Three key qualifications have run through the history of the company like a golden thread: innovations, quality and reliability.

These three characteristics have been closely linked with the company since its foundation in 1969. They are central to the company's success story and its excellent worldwide reputation. For steel producers around the globe, SMS Mevac is synonymous with most advanced treatment and refining technology for liquid steel.

Future-oriented

Jochen Schlüter, CEO of SMS Mevac GmbH: "Our 50th anniversary fills us with pride. Throughout our history, we have developed numerous trend-setting technologies for our industry, which serve our customers to make high-quality products. But in our anniversary year we also look ahead into the future, as ▶

we are determined to continue strengthening our competitiveness – and in particular the competitive position of our customers – with innovations as we have done in the past. We create process routes for new and optimized materials that open new perspectives.”

A year of breakthroughs: 1969

1969 was the year of the first moon landing, of the maiden flight of the Jumbo Jet and the year of stylish cars like the BMW Coupé or the Ford Capri. We owe these accomplishments to industries which as early as at that time were in need of high-quality steels. Therefore, 1969 was a significant year also for the steel industry. On 1 July 1969, Hoesch AG and Fried. Krupp Hüttenwerke AG founded Vacmetal Gesellschaft für Vakuummetallurgie mbH. Both companies brought to bear their respective competences and developed and implemented pioneering secondary metallurgy solutions.

Over time, the company has seen various different owners. Since 1997, it has been part of the SMS group of companies. During the first years as a company of SMS group, there were more restructurings, mergers & acquisitions and name changes, eventually – in 1999 – leading to SMS Mevac as we know it today. The name was derived from the pre-merger companies Messo and Vacmetal. The merging of competence from Standard Messo and Vacmetal into SMS Mevac resulted in a to date unparalleled lead in technology. Customers of SMS Mevac get technology from the cradle of secondary metallurgy. This technological leadership has been consistently expanded over the past decades.

Forerunners in secondary metallurgy

Notwithstanding its numerous name changes, SMS Mevac has remained true to its principles during all its 50 years of history. Till the present day, the company has stood for high reliability, flexibility and continuity.

SMS Mevac has developed, designed, built and commissioned secondary and ladle metallurgy plants for an extremely wide range of customer and market requirements. From the early days of the company till the present time, these plants have formed the link between primary crude steel production in the meltshop



“Also in future, we will strengthen our customers’ competitiveness with our innovations.”

Jochen Schlüter, CEO of SMS Mevac

and downstream continuous or ingot casting of the liquid steel refined into quality steels in the SMS Mevac plants.

Secondary metallurgy processes relieve much of the treatment effort from the meltshop, as treatments such as alloying, heating, degassing and desulfurizing are performed downstream, in treatment ladles. The mentioned process steps take place partly under atmospheric pressure and partly in a vacuum generated by mechanical vacuum or steam-ejector pumps. When the company was founded in 1969, secondary metallurgy processes were just about to become established as part of the process chain in steelworks. Today they are an indispensable element of modern steelworks as well as, or especially, for future developments in steelmaking.

Tertiary metallurgy

A further, more recent area of activities of SMS Mevac is tertiary metallurgy. Its objective is to produce isotropic materials for extremely challenging applications. These materials are mainly used in sectors such as the aerospace, energy, automotive as well as oil and gas industries. Also in this area, SMS Mevac will not cease to align to the changing requirements of the market towards increasingly higher-grade products. In this way, the company will con- ▶

1970

British Steel Corp.,
Port Talbot Works
UK, DH plant, 340
tons, built in 1970
(today Tata Steel)

1983

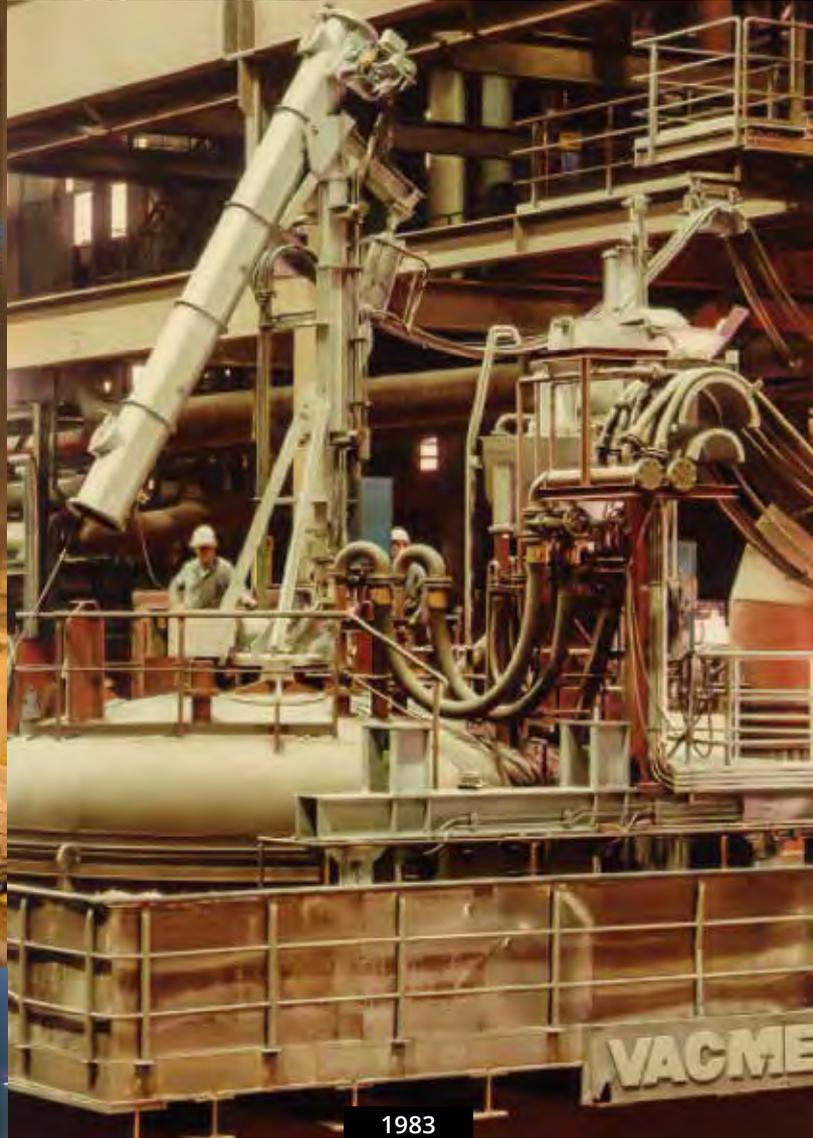
KruppStahl AG,
Bochum, Germany,
100-ton VD

1988

British Steel Corp.,
Llanwern Works UK,
first Duplex-RH
plant, 200 ton,
commissioned in
1988

2001

EKO Stahl, hot-metal
desulphurization
plant with
2 stations, 205 tons
charge weight, first
Eco-injection plant,
today ArcelorMittal
Eisenhüttenstadt,
Germany





1963



1985

tinue to be able to supply new solutions that meet its customers' ever growing requirements.

Jochen Schlüter: "We at SMS Mevac feel committed to the general motto of SMS group. As the Leading Partner in the World of Metals, we support our customers as partners, with tailor-designed and customized plant solutions. By supplying economically efficient, innovative technologies and services for future-oriented refining processes for liquid steel, we make a lasting and sustainable contribution to modern steel-making. While we give steel added value, our customers benefit from our outstanding metallurgical and process know-how. And this has been the case for 50 years now!"

Ever since its foundation 50 years ago, SMS Mevac has offered a holistic solutions-oriented product and service portfolio: research & development, engineering, equipment supply, supervision of installation and commissioning, training, services to ensure smooth plant operation, and efficient plant upgrading. In all its activities, SMS Mevac places a strong focus – in addition to quality and productivity – on sustainability, i.e.

environmental protection and maximized energy efficiency. Plants from SMS Mevac are examples of how ecology and economy can go together perfectly to the benefit of the customer.

For SMS Mevac, a long-term partnership is key to its customer relations. For the customer, this provides the long-term benefit of stable processes and joint advancement. With a view to the future, SMS Mevac has been developing solution-oriented concepts and services for highest-efficiency secondary metallurgy processes to be successfully implemented at the customers' operations.

Digitalization for more customer value

As an integral part of SMS group, SMS Mevac supports all the other business areas of the group in offering the customers integrated solutions from a single source. The advantage of this close coordination is that the systems are optimally aligned with the up and down-

1963

Stewards & Lloyds, first RH plant in Bilston, Wolverhampton, England

1985

Sollac, Dunkirk (formerly Usinor), RH-OB plant, 240 tons

2012

NLMK, Russia, 320-ton Duplex-RH-TOP plant

2012

Dragon Steel Corp., Taichung, Taiwan, 210-ton RH-TOP plant



2012

stream plants and processes. The fact that the interfaces are perfectly harmonized all the way through is particularly important with a view to digitalization and Industrie 4.0. "I'm happy to say that in the year of our 50th anniversary we are excellently positioned for the future. We have highly attractive orders for our VD, VOD, RH, LF and LTS plants in the pipeline and are very positive about the outcome of ongoing project negotiations. Our teams are highly motivated and our customers can look forward with us to the new potentials provided by digitalization," says Jochen Schlüter. ♦

**Jochen Schlüter**

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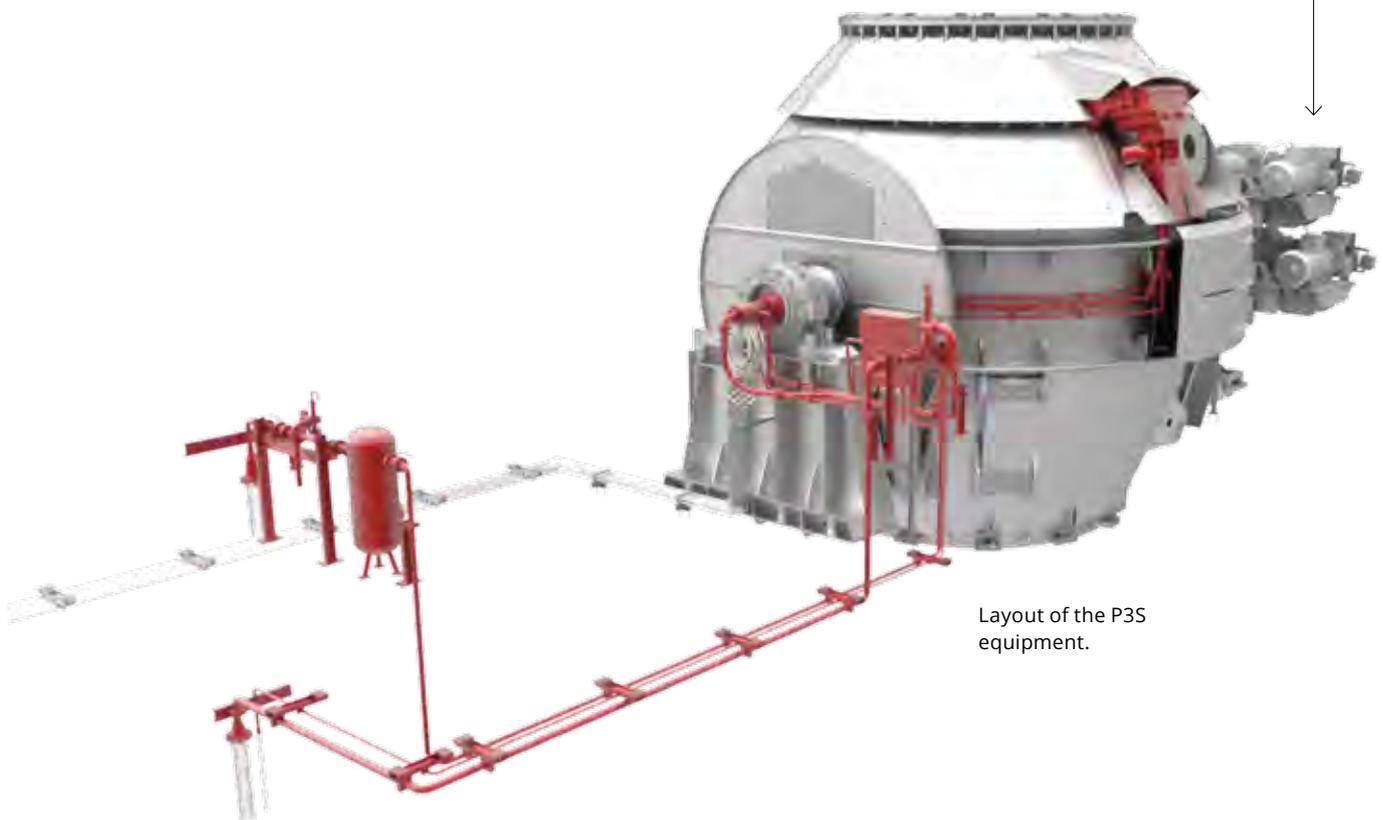


2012

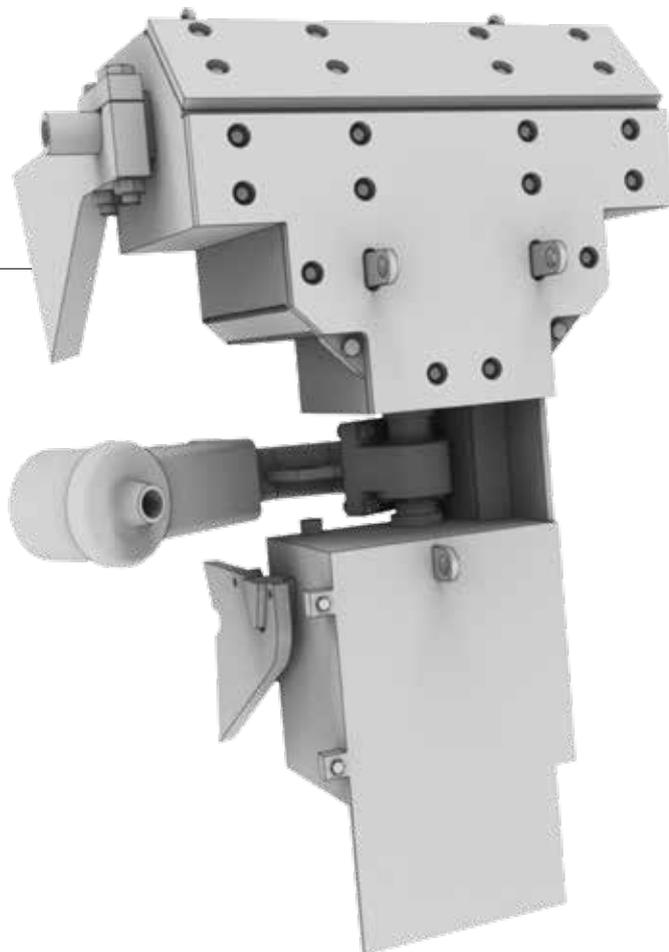
WORLDWIDE

P3S – PNEUMATIC SLAG STOPPER SYSTEM

The pneumatic slag stopper system developed by SMS group minimizes slag carry-over and reduces the operating costs in the long term.



Layout of the P3S equipment.



P3S –
pneumatic slag
stopper system.

FEATURES

- P3S reduces the amount of slag carried over into the steel ladle
- Compact design, arranged within the rotating circle of the converter
- The stopper arm/nozzle follows the tap hole position
- Slag stopper housing fitted with air cooling extends life time of the equipment
- Slag retention function independent of the converter tilting speed
- Ease of retrofit

ADVANTAGES OF P3S

- Reduces operating costs by minimizing slag carry-over
- Low rephosphorization of the steel
- Suitable to be retrofitted and commissioned during a scheduled maintenance stop
- Easy to integrate into the existing automation environment of the converter
- Reduced consumption of deoxidation agents

In the production of high-grade steels and in order to reduce the amount of alloys used to compensate residual slag in downstream production stages, it is essential to prevent the carry-over of slag during tapping. The pneumatic slag stopper developed by SMS group concludes the tapping process at the BOF by injecting inert gas from outside into the tap hole when steel tapping reaches its end. The pivoting movement of the slag stopper arm is performed by a pneumatically actuated rotary drive, which is directly coupled with the drive shaft of the slag stopper. This function is triggered by an infrared signal coming from the slag detection system. The rotary drive does not need longer than a second to bring the slag stopper arm into its working position. The nitrogen flow starts automatically. While the injected nitrogen pushes the slag back and prevents it from being tapped, the converter vessel is being tilted back into its upright position. Once the converter is no longer in the tapping position, the slag stopper is pivoted back to its parking position and the nitrogen flow stops automatically. ◆



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CHINA

IMPROVING PRODUCT QUALITY

Nanjing Iron and Steel Group Co., Ltd. orders upgrade for continuous caster from SMS Concast.

Nanjing Iron and Steel Group Co., Ltd., a leading Chinese steel producer with approximately ten million tons of steel produced per annum, has awarded SMS Concast AG an order to upgrade the four strands of continuous caster CCM4 at its Nanjing plant No. 2. The targets of the project are to improve product quality and productivity, to increase flexibility in the processing of a vast steel grade portfolio and also to reach an annual production of more than 800,000 tons of steel.

The four-strand continuous caster with a nominal radius of 12 meters will cast two bloom section sizes, namely

250 x 300 and 320 x 420 millimeters. The product mix will include a large proportion of high-carbon grades like bearing and spring steels and the full range of steel grades demanded by the automotive industry. This product portfolio will allow greater production flexibility and responsiveness to the market demand.

The casting machine will be equipped with the latest technological design to make this caster one of the most modern installations worldwide. Features like dynamic mechanical soft reduction (DMSR) shall improve the inner quality of the blooms by means of special reduction modules

Contract signing by Xu Xiaochun, General Manager Nanjing Iron and Steel Group Co., Ltd., and Pierpaolo Rivetti, Sales & Marketing, SMS Concast.

designed to reach the necessary reduction ratios for an accurate control of core porosity and segregation. The complete control of the soft/hard reduction (DMSR) system is delegated to the COOL real-time solidification model. This online simulation tool is a proprietary system developed by SMS Concast. It dynamically calculates the temperature profile along the entire strand and defines the roll gap and the reduction forces in the respective modules of the straightening unit. The spray cooling is also dynamically readjusted in accordance with the calculated cooling profile.

PREVENTIVE QUALITY CONTROL

In addition to the DMSR system, the modernization project includes other technological and digital solutions such as CONFLOW tundish stopper mechanism for a precise control of the steel flow to the mold, INVEX® mold tube technology with the latest cooling features and a hydraulic tandem oscillation system allowing for several oscillation parameters. The electromagnetic mold and final stirrers (CONSTIR MEMS and FEMS) together with the SMS Concast CONSTIR-MWS tool (modulated wave stirring) optimize stirring efficiency with an energy saving of 30 percent and more. The list of technological packages is rounded off by an air-mist spray cooling system and bloom deburring equipment. A robot-type slide gate manipulator will also be installed to increase safety and extend unmanned operation on the casting floor.

The electrical and automation system has the prime purpose of automatically controlling the operation of the caster (no-man casting). At the same time, the level-2 computer system tracks and records all quality-relevant parameters and provides a detailed cast report for each bloom. This preventive software module includes automatic sample cutting, computerized slice-by-slice identification and bloom tracking for optimal quality control, optimized residual length calculation and recording of the equipment life time.

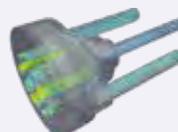
In order to minimize shutdown times, particular attention was paid to project planning and to the delivery schedule in order to achieve quick implementation. The modernization is scheduled for completion in the fourth quarter of 2019. ♦

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Lower operating costs – higher productivity

Nanjing Iron and Steel upgrades electric arc furnace with injector technology from SMS group

Nanjing Iron and Steel Co., Ltd., China, has placed an order with SMS group to supply new SMS group ConSo R6 injectors for the electric arc furnace No. 3 in Luhe, Nanjing. Erection and commissioning of the equipment are scheduled for 2019.



Design study by computational fluid dynamics (CFD).



3D design of the SMS group ConSo R6 injector.

The main goal of the upgrade is to cope with the future reduction of hot metal by replacing it with scrap in the charge. For this purpose, efficient injector technology is required. Furthermore, the upgrade will reduce operating costs and increase productivity.

The injector design was developed using computational fluid dynamics (CFD). Having ten percent less weight than the previous version, the new lightweight construction is particularly easy to maintain.

The SMS group ConSo R6 water-cooled copper boxes in monoblock design are not susceptible to cracking and effectively prevent water leakage. The integrated flashback detection system allows continuous monitoring of the ConSo

R6 injector which can be operated in burner or oxygen injector mode. The injector additionally provides for automatic management of the melting profiles, ensuring excellent efficiency.

The SMS group scope of supply includes three ConSo R6 injectors, water-cooled copper boxes, the respective valve stations, an integrated flashback detection system as well as supervision of the erection and commissioning activities. ♦

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PERU

ENERGY-EFFICIENT STEEL AND BILLET PRODUCTION FOR PERU

Aceros Arequipa orders steel mill and continuous billet caster from SMS group.

- **Equipped with cutting-edge technology**, the new steelworks of Corporación Aceros Arequipa in Peru will feature high productivity.
- **The supply scope includes** a 120-ton AC electric arc furnace, a gas cleaning plant, a billet caster as well as all electrical and automation systems.

Corporación Aceros Arequipa S.A. (CAASA), based in Arequipa, Peru, has awarded SMS group an order covering the supply of a new steel mill and a billet caster with six strands for its Pisco site. The plant will be designed for an annual capacity of 1,200,000 tons and will produce billets with sections of 130, 160 and 180 millimeters. Commissioning is scheduled for early 2020.

In terms of the steel mill, SMS group will supply a 120-ton AC electric arc furnace equipped with innovative technology to secure high productivity. A CONDOOR automated slag door will reduce downtimes and thus make the process more efficient. The CONSO injection system, in combination with the AEREG electrode controller, will permit over 180 tons of steel to be produced every hour in a steady and continuous process. SMS group's scope of supply also includes a ladle furnace meeting all requirements with regard to the respective steel composition. ▶





Electric arc furnace from SMS group: highly productive and energy-efficient.

The steel mill will be equipped with a gas cleaning plant capable of processing over 2,200,000 cubic meters of process gas per hour, with the Frustum exhaust hood from SMS group permitting the gases produced during furnace charging and tapping to be captured and extracted more effectively. The gas cleaning plant will comply with the strictest environmental regulations.

PROVEN EQUIPMENT WITH HIGH PERFORMANCE

SMS Concast, a company of SMS group, will supply a continuous billet caster with six strands. The caster will have a casting radius of nine meters and be equipped with the proven CONVEX mold, a technology that is both widespread and well-established on the market. The special inside geometry of the mold allows for a greater transfer of heat across the whole mold, with a uniform degree of solidification in the corners. The efficient strand shell guidance in the mold with maximum symmetrical cooling not only increases the casting speed but, at the same time, improves the quality of the cast product. The CONFLOW tundish stopper is used to ensure a stable flow of steel and a reliable casting process. CONSTIR, an electromagnetic stirrer used as mold and final stirrer, ensures the required metallurgical quality. A new alternating oscillator allows for high flexibility and thus enhanced productivity.

A significant reduction in operating costs will be achieved thanks to the direct connection to the rolling mills. Depending on the desired quality, the billets can be rolled directly or be taken to the rolling mill after a slow cooling process.

SMS group's scope of supply includes basic and detail engineering, supply of all mechanical and electrical compo-



The cooling chamber of a billet caster.

1,200,000

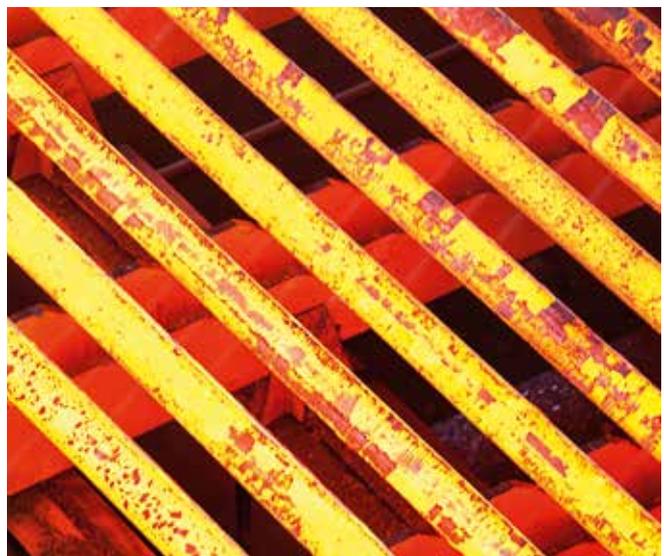
tons will be the annual capacity of the new steel-works at Corporación Aceros Arequipa. As from 2020, it will produce billets of 130, 160 and 180 millimeters square.

nents, the complete electrical and automation system including an integrated process control system (level 2) which monitors the steel quality from the scrap yard to the billet storage area, as well as the supervision of erection and commissioning. Aceros Arequipa manufactures long and flat steel products, including corrugated iron, wire rod, steel profiles, bars and tubes, as well as steel tools and components for the construction, civil engineering and mining industries. The company supplies the local market and exports to Columbia, Ecuador, and Bolivia.

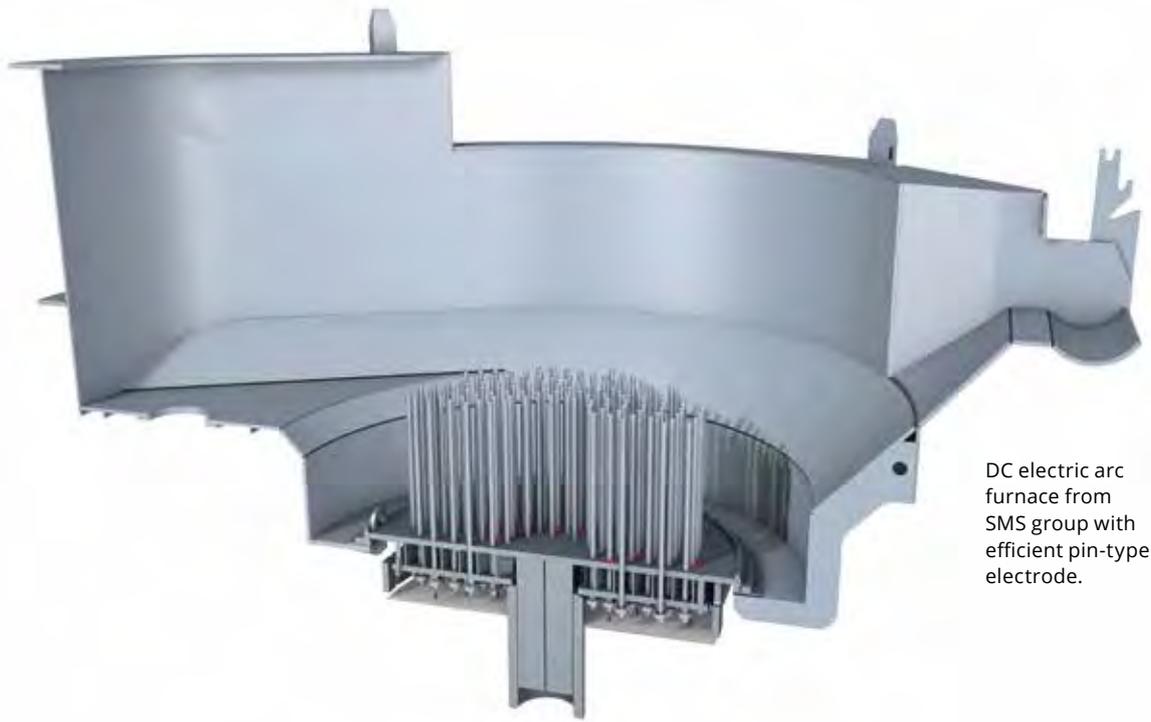
The new plant will allow Aceros Arequipa to expand its presence on the local market and in South America and to offer higher-quality products. ♦



More information
www.sms-group.com



Billets on a turnover cooling bed.



DC electric arc furnace from SMS group with efficient pin-type electrode.

CHINA

MODERNIZATION EXTENDS LIFETIME

Daye Special Steel is going to use a pin-type bottom electrode from SMS group in its electric arc furnace.

Daye Special Steel Co., Ltd. has awarded SMS group the contract to upgrade a 75-ton direct-current electric arc furnace (DC EAF) at its plant in Xinyegang, China.

COMMISSIONING PLANNED FOR 2019

As part of the upgrade, the existing furnace will be scanned in 3D and the bottom part of the electric arc furnace vessel modified.

SMS group is supplying two new pin-type bottom electrodes and a high-current system with optimized arrangement to reduce deflection of the electric arc. SMS group will also supervise installation and commissioning.

The upgrade is aimed at reducing operating costs and increasing productivity. The pin-type bottom electrode requires no maintenance, and the condition of the electrode is continually monitored by thermocouples. The needle-shaped electrode boasts a long service life, and the optimized arrangement of the bus bar system means the

refractory lining lasts longer. Thanks to the easy connection of the bus bar system, the furnace vessel can be changed in just a short time. For the lining, expensive conductive bricks have been replaced with cost-effective ramming mix. Safe working conditions for the operating crew are guaranteed as the bottom electrode is cooled with air and not water.

The DC EAF technology from SMS group offers a host of benefits: less power network interference, lower noise level, reduced electrode and refractory material consumption, and lower energy input.

The direct-current electric arc furnace generates a strong stirring motion in the steel bath, improving not only the temperature and homogenization but also the quality of the tapped liquid steel. ♦



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OMAN

IMPRESSIVE PRODUCTION RAMP-UP

Successful commissioning of high-speed billet caster at Jindal Shadeed Iron & Steel LLC, a company of Jindal Group.

In Sohar, the Sultanate of Oman, Jindal Shadeed Iron & Steel LLC (JSIS) and SMS group have successfully put into operation a new high-speed billet caster with six strands. Within about just one month from hot commissioning, it was possible to increase the sequence length to 42 ladles per sequence – an impressive confirmation of a steep ramp-up curve.

TWO MILLION TONS ANNUAL CAPACITY

The continuous casting machine was designed and commissioned by JSIS in cooperation with SMS Concast, a company of SMS group. The caster is currently operating with six strands and produces square rebar billets of 165 millimeters cross-section at a casting speed of 3.6 meters per minute. However, provision is made for an expansion to eight strands and for enhancing the product portfolio by further billet sizes in the range from 130 to 200 millimeters square. At casting speeds of up to 5.0 meters per minute, these enhancements will permit an annual capacity of two million tons to be achieved. Apart from the integrated CONVEX mold technology, JSIS

counts on further technological packages from SMS Concast permitting the production of SBQ steel grades. These packages include the CONFLOW stopper control ensuring an optimum and stable steel flow and CONSTIR mold stirrers. The integration of electromagnetic mold stirrers helps improve product quality, especially in terms of center segregation.

Sanjay Anand, Chief Operating Officer at JSIS Oman, congratulates the team led by Vishnu Vijay (Head Project & Rolling Mill) and the SMS team on commissioning the project within just four months from arrival of the first major equipment components on site:

“Thanks to the great cooperation of the project teams, we were able to achieve an impressive ramp-up in production. 42 melts in sequence were cast within about one month after commissioning.” ♦

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INDIA

200,000 TONS OF STEEL PER MONTH

Jindal Steel & Power Limited (JSPL) has successfully commissioned its seven-strand high-speed combi-caster.

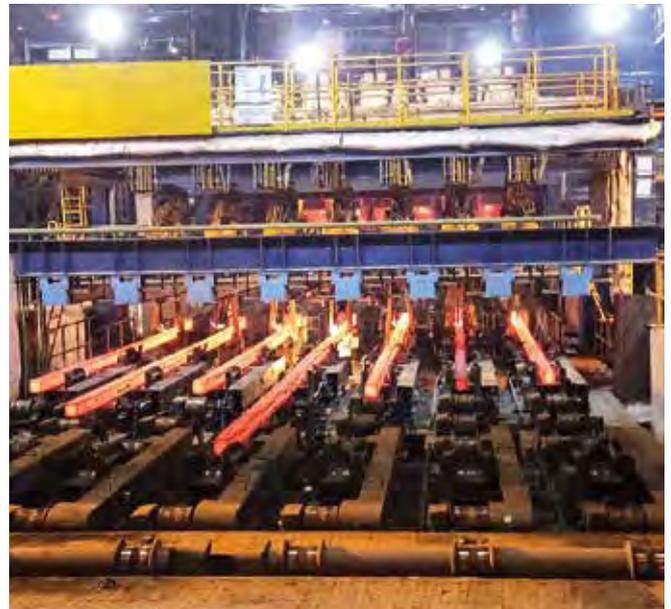
This combi-caster in the Angul works is the largest high-speed billet caster in India. It was commissioned within twelve months only from project start with excellent results. The combi-caster was developed in cooperation with SMS Concast, a company of SMS group, for the production of low-carbon and also high-carbon grades from free-cutting to ball bearing steels. With a casting radius of nine meters and seven strands, the caster's speed range is between 0.6 and 5 meters per minute. The facility features the continuous straightening concept of SMS Concast, and its maximum production capacity is 2.3 million tons per year of 165 x 165-millimeter square billets. The casting formats include billets of 150 x 150 up to 200 x 200 millimeters cross-section, however, in the future the company intends to additionally cast round sections in the diameter range from 162 to 220 millimeters.

At present, JSPL casts square billets of 165 x 165 millimeters with the new combi-caster. In the closed casting mode, a volume of maximum 1.8 million tons per year can be produced. The maximum casting speed for 165 x 165-millimeter square billets is 3.6 meters per minute in the open mode, whereas in the closed mode it is 2.8 meters per minute.

ALL FROM ONE SOURCE

Jindal Group already operates two six-strand billet casters from SMS Concast in Raigarh and three eight-strand billet casters, two thereof in Angul and one in Shadeed, Oman. Thanks to the CONVEX Technology® installed in this new high-speed combi-caster, JSPL will benefit from lower operating costs, among others.

"The machine allows us to achieve higher productivity which was topped in December 2018 with 200,000 tons of steel per month," says Atul Dubey, VP, Steel Melt Shops at Jindal Steel & Power Ltd. in Angul. He congratulates the two project teams led by S.S. Nagi, JSPL, and P.P. Mandape,



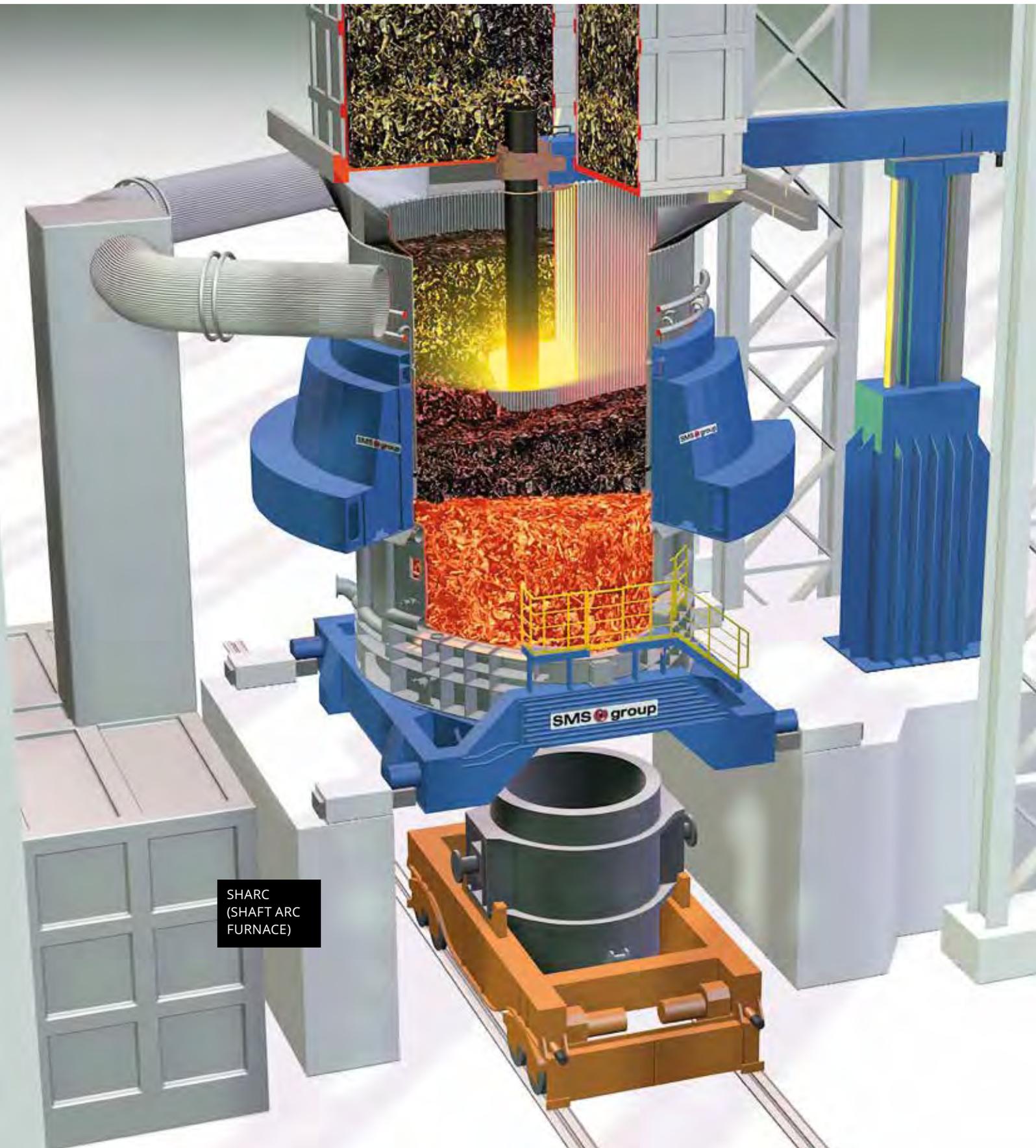
High-speed, seven-strand combi-caster in operation at JSPL Angul, India.

SMS Concast, for the efficient commissioning twelve months after project start.

JSPL produces a wide range of iron and steel products, including plates, parallel-flanged beams, medium sections, rails, rounds, rebars, wire rod and other metal products. ◆



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SHARC
(SHAFT ARC
FURNACE)

CHINA

REDUCED EMISSIONS

SMS group is going to supply two SHARC (Shaft Arc Furnaces) and a vertical continuous bloom caster to Shijiazhuang Iron & Steel Co., Ltd. (Shigang).

In March 2019, Shijiazhuang Iron & Steel Co., Ltd., a company of the HBIS group, placed an order with SMS group for the supply of two 130-ton SHARC (Shaft Arc Furnaces) and a three-strand vertical continuous caster.

Since October 2014, Shigang has been planning to relocate all of its steelmaking facilities to Jing Xing, an iron ore mining area 80 kilometers from the Chinese city of Shijiazhuang. Both the decision to relocate the steel plant and the choice of the EAF route instead of the BF/BOF route follow the Chinese government's current strategy of reducing harmful emissions and improving the air quality. With this project, Shigang will set a new standard in terms of cleaner, more flexible and more efficient steelmaking in China. Commissioning of the complete steel plant at the new location is scheduled to take place as early as at the end of 2020.

VERTICAL CONTINUOUS CASTER

Converting the production process from ingot casting to continuous bloom casting in a vertical machine will provide Shigang higher productivity. The vertical continuous caster, developed by SMS Concast, a company of SMS group, will produce blooms with cross-sections of 460 x 610 millimeters and in lengths between 4.5 to 6.1 meters. The plant will come with many technological packages, enabling the production of special steels for a broad range of applications and a wide selection of alloy grades. These technological features include the INVEX® mold, CONSTIR mold and final stirrers, a high-precision tandem resonance oscillator, finely adjustable air-mist secondary cooling consisting of seven independent cooling zones, seven double-roller modules for ▶

SHIJIAZHUANG IRON & STEEL (SHIGANG)

was founded in 1957. Today the company produces approx. 2.5 million tons per year of SBQ products, mainly for the automotive sector. Shigang is one of the largest companies within the HBIS group (Hegang group), which, with an annual steel output of 43 million tons, is the world's third largest steel producer.

metallurgical soft reduction and an inline de-burring system. The caster will be equipped with a control system of the latest design and a Level-2 system that, among others, will provide gapless, fully digitalized quality tracking of the cast blooms.

SHARC – THE TECHNOLOGY OF CHOICE

When Shigang decided to switch from the BF/BOF route to the EAF route in the steel plant at the new site, the next step was to select a technology that would provide a most energy-efficient way of scrap melting. The two SHARC furnaces will be designed for an annual capacity of more than two million tons of liquid steel, at a tap-to-tap time of 45 minutes. Special about the SHARC design is the unique approach to scrap preheating, which exploits otherwise unused energy in the extracted waste gas. The SHARC furnaces will be set up and operated in separate halls sealed against the other parts of the plant and the outside atmosphere. This solution abates noise and reduces the environmental impact on the other areas of the plant. The main components of the SHARC's scrap preheating system are the hydraulically and independently actuated fingers arranged at the circumference of the furnace. These fingers hold the scrap in the preheating position until it has reached a temperature of about 500 degrees centigrade. As soon as the preheated scrap has

been charged from the preheating zone into the furnace vessel, it is melted by means of the direct-current electrodes and the SIS combined burner/injector system developed by SMS group. This combined input of energy is highly efficient and minimizes the scrap melting time. The SHARC technology comes with a flue gas cleaning system of the latest design.

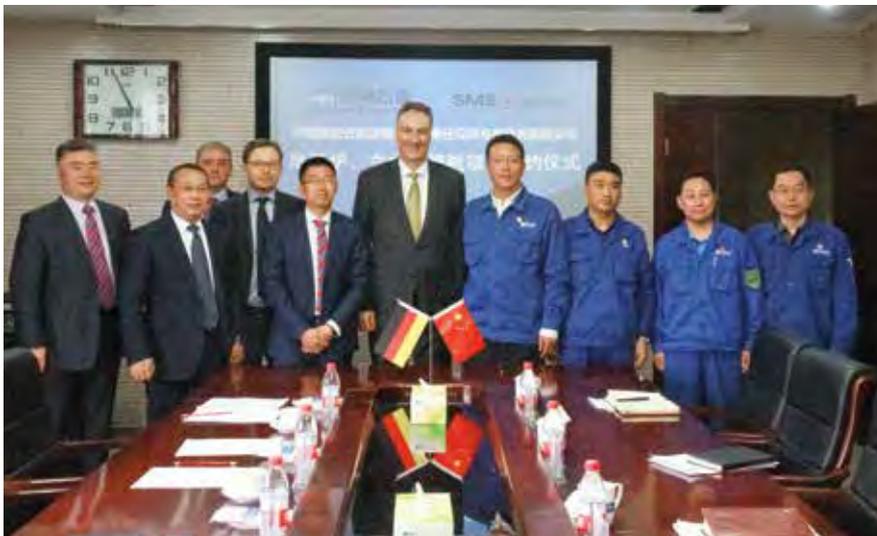
DIGITAL PRODUCTION PROCESS

The vertical continuous caster will be equipped with an advanced automation system enabling strict quality control and reliable quality tracking. Moreover, the system will follow a productivity optimization strategy to achieve the best possible return.

All operations to be performed at and around the SHARC will be automated in order to increase work safety. SMS group will also supply the advanced automation system needed for these highly demanding tasks. ♦

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Pierpaolo Rivetti (for vertical continuous caster)
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The contract for this large-scale project in China was signed at Shijiazhuang Iron & Steel Co., Ltd. (Shigang) on 19 March 2019.





Vertical continuous casting.

FINLAND

AVAILABILITY INCREASED

Outokumpu, one of the world's leading stainless steel producers with headquarters in Helsinki, Finland, has contracted SMS group for the revamp of the fume treatment plant at its works in Avesta, Sweden. Commissioning of the modernized plant is scheduled for August 2019. As part of the supply, SMS group will add a water-cooled duct to the main duct system of the fume treatment plant as well as a new closed water cooling system based on the hot-water technology. The design of the modernized plant will prevent limestone from depositing inside the equipment, ruling out the risk of thermal fatigue cracking. The new cooling system will provide better resistance to corrosion, increasing as a result the lifetime of the fume treatment plant and significantly reducing the required maintenance effort in the future. ◆



More information
www.sms-group.com

WORLDWIDE

A REVOLUTIONARY SENSOR

A compact unit improves product quality by measuring the mold level and the flux powder level at the same time.



Figure 1:

CONGAUGE LB 6755 is a radiometric detector featuring a mechanically adaptable installation frame. This makes it easy to retrofit the gauge in minimum time to existing GAMMA-cast LB 6752 systems.

In order to achieve a uniform casting behavior in the mold and optimal product quality, both the level of the liquid steel in the mold and the thickness of the flux powder covering the steel must be controlled with greatest accuracy in continuous casting plants. The inflow of steel into the mold is controlled via measurement of the liquid steel level (meniscus). For a stable continuous casting process it is essential that this measurement is reliable, correct and that it provides the results instantly. The flux powder serves many purposes: It protects the liquid steel against oxidation and, in the form of molten slag, it serves as lubricant between the solidified steel shell and the mold, provides thermal insulation of the meniscus and makes for uniform heat exchange between the steel and the mold. Care has to be taken that the flux powder melts appropriately and in sufficient amount. Otherwise the consequences may be severe casting defects or even the need to abort the casting process.

Conventional sensors used so far in mold level gauges have only been able to measure either the level of the liquid steel in the mold or a mixed signal as a combination of the steel and the powder levels in the mold. Measuring both levels separately used to require two independent measuring techniques working on different physical principles. The solutions involving two separate devices, however, entail high costs, increase the maintenance effort and make the evaluation of the measured results a rather cumbersome procedure. The newly developed CONGAUGE LB 6755 sensor solves exactly this problem as it combines both level measurements within one unit. In addition to new plants, the sensor can just as well be retrofitted to existing casting plants (see figure 1). Particularly producers of high-grade steels will benefit from this new development.

IMPROVED CONTROL OF THE CASTING PROCESS

While the new radiometric multi-tasking sensor is based on the commonly used, fast and reliable radiometric mold level measurement principle, it is yet capable of simultaneously measuring the steel level and the thickness of the covering layer of flux powder in the mold (see figure 2). The availability of both measurements at the same time provides a clearer picture of the situation in the mold, allows for better control of the casting process and, as a result, increases the quality of the cast product. The new CONGAUGE LB 6755 sensor has been developed in close cooperation between SMS Concast and Berthold Technologies, based on a proof of concept devised by SMS Concast, and taken to industrial maturity by the two companies. The performance capability of the new sensor has been proved in successful trials on continuous casting machines at the German steelmakers Saarstahl AG and

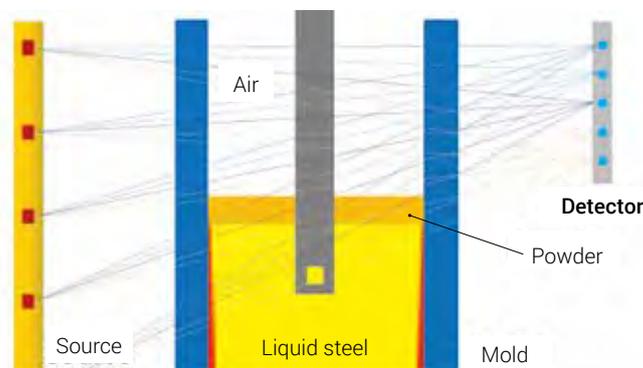


Figure 2: The enhanced radiometric measurement provided by the CONGAUGE LB 6755 multi-crystalline sensor.

Lech-Stahlwerke. The system sends out three different signals. The first signal provides the classical radiometric measurement of the mold level. The second and the third signals allow to differentiate between the actual steel level and the actual thickness of the covering flux powder in the mold. Thus operators of continuous casting plants can benefit from a compact gauge with a sensor that allows - in addition to a closed control loop for the meniscus measurement - the set-up of a closed loop for the control of customary flux powder feeding systems. The latter are still commonly controlled by open-loop systems as the changing powder level as a result of the powder feeding makes the measurement quite difficult. However, with CONGAUGE LB 6755 it is now possible to establish a reliable, automated powder feeding system that makes for more precise control of the flux powder layer in the mold. To summarize, it can be said that with CONGAUGE LB 6755 initial shell forming can be controlled more effectively because now the actual liquid steel level in the mold is known. Moreover, the newly available information allows the operator to set up a closed control loop for the automation of the powder feeding system. This makes CONGAUGE LB 6755 a compact Industrie-4.0 application capable of ensuring a constant flux powder level throughout the casting campaign. As a result, CONGAUGE LB 6755 helps to significantly improve the metallurgical properties of the final product. ♦



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CHINA

EFFICIENT PROJECT EXECUTION

Jiangsu Yonggang Group granted SMS Concast the FAC for upgrading a four-strand billet caster.

Chinese company Jiangsu Yonggang Group Co., Ltd. granted SMS Concast, a company of SMS group, the FAC (Final Acceptance Certificate) for the modernization of a billet caster in Zhangjiagang. The existing caster was replaced by a new four-strand facility. This modernization helps the customer expand its product portfolio by high-quality steel grades (SBQ).

The continuous casting facility was provided with many technological and digital solutions by SMS Concast in order to achieve a flawless production process, high quality products and increased productivity.

DIGITAL SOLUTIONS FOR BETTER QUALITY

The continuous caster was redesigned for the flying tundish production concept, a method to increase operation time and yield of the caster. Furthermore, the tundishes were



equipped with the CONFLOW stopper control assuring a precise and stable steel flow for reliable casting and requiring very little maintenance. Apart from the mold electromagnetic stirrer CONSTIR-MEMS, the final stirrer CONSTIR-FEMS helps achieve the required product quality in terms of center segregation and center porosity. The spray cooling system is equipped with SMS Concast's AIRMIST spray nozzles offering a uniform and softer cooling at lower water consumption. Additionally, for bigger sections there are plans for the application of dynamic mechanical soft reduction (DMSR). This will be possible thanks to SMS Concast's COOL simulation software which models the temperature profile of the hot steel strand in real time and thus allows the casting process, including spray cooling and DMSR, to be optimized online. Online adjustment of the spray cooling system prevents cracks due to internal reheating.

A further digital solution is heat tracking as part of the level-2 system. This module allows the quality of each melt to be meticulously traced down to single billet slices and thus enables the operator to predict quality events and to improve production yield. "The cooperation with SMS Concast AG paired with a fast and smooth execution of the contract helped us commission our new SBQ billet caster within five months only from the start of erection," says Liu Jinbu, Plant Director of Yonggang, Steel Making Plant, with satisfaction. ♦

 **Pierpaolo Rivetti**
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The new billet caster with a capacity of 540,000 tons per year was commissioned only five months from installation start. The section sizes range from 150 to 220 millimeters square.



The finishing mill during the commissioning phase at the end of the 1980s.

CHINA

NEW DESCALING CONCEPT IN FINISHING MILL FOR SILICON STEEL GRADES

After the modernization at Baosteel, the operational results met the expectations and project objectives to the full extent.

Hot rolling of steel grades with high silicon content produces red scale that must be removed in order to prevent a lowering in product quality and a significant impairment of the processes to follow. And that was the demand of Baoshan Iron & Steel Co., Ltd. (Baosteel) for the modernization of the finishing mill descaling system in its 2,050-millimeter hot strip mill No. 1 in Shanghai, China. SMS group complied with these requirements by increasing the operating pressure up to 400 bars, adapting all related components, and installing the latest nozzle technology within a period of merely nine months.

The most essential step in the descaler modernization was the installation of a new high-pressure piston pump system, including related drive equipment, and of all necessary mechanical components and pipework. SMS group integrated the new HP descaler control unit into the available automa-

tion system. Together with the frequency-controlled drives, this allows for an energy-optimized mode of operation adapted to the requirements of the respective product. Additionally, a condition monitoring system was installed for preventive maintenance to increase plant availability and reduce operating costs.

The descaler upgrade of the mill built in 1989 could be managed within two short shutdowns, the change to the new descaling system took two days only. ♦

 **Ralf Setzer**
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The new cold rolling mill for copper strip supplied by SMS group rolls strips with widths of up to 1,350 millimeters in premium quality.



CHINA

START-UP AT RECORD SPEED

Zhejiang Huayuan Copper successfully commissions copper-strip cold rolling mill supplied by SMS group.

On December 29, 2018, the new cold rolling mill for copper strip supplied by SMS group has successfully started operation at the Chinese producer Zhejiang Huayuan Copper Co., Ltd. The implementation of the mill, from order intake to commissioning, took a project duration of about 15 months only.

The cutting-edge mill in six-high design with proven CVC® plus technology (Continuously Variable Crown) started operation on December 29, 2018 – this is already 34 days prior to the contracted due date. From the date of rolling the first strip to 1.2 millimeters final thickness at 1,050 millimeters strip width, further commissioning and the optimization of plant performance have been proceeding efficiently, and will allow Zhejiang Huayuan Copper Co., Ltd. to produce the complete product range with strip widths of up to 1,350 millimeters and a minimum final gauge of 0.15 millimeters before long.

Zhejiang Huayuan was very pleased with the performance of SMS group and regards this a confirmation of its decision to select SMS group as single-source supplier.

34

days prior to the contracted due date, the copper-strip cold rolling mill supplied by SMS group to Zhejiang Huayuan went on stream.

Beside the engineering, the supply of mechanical components and the X-Pact® electrical and automation systems, the scope of supply also includes site services and commissioning. Prime responsibility for order execution is with the Chinese SMS Siemag Technology Co., Ltd., a company of SMS group. Core components for the CVC® plus roll shifting technology determining the quality of the rolled products and the resource-saving rolling of the valuable copper material were supplied by SMS group from Germany.

The Chinese customer located in Huayuan ranks among the leading providers of copper strip worldwide. Looking at the available strip width, it even takes the top position worldwide. ♦



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ITALY

DIGITAL ASSISTANCE SYSTEM IMPROVES YIELD

SMS group supplies high-performance Compact Cold Mill to Marcegaglia.

Marcegaglia Ravenna S.p.A. has contracted SMS group for the complete supply of a two-stand reversing cold mill of CCM® (Compact Cold Mill) design. Marcegaglia's headquarters are located in Gazoldo degli Ippoliti, in the Mantua province in North Italy.

The new CCM® will be built at the Ravenna site where Marcegaglia produces cold-rolled carbon steel sheets and strips for a wide range of industrial applications. As a high-performance mill, it is designed to process a comprehensive versatile material mix, including high-carbon and duplex steels, chrome-manganese alloyed steels, and silicon steels. The annual capacity is about 550,000 tons.

Depending on the product mix, it rolls strips with widths of between 750 and 1,570 millimeters and entry thicknesses ranging between 0.60 and 5.00 millimeters. The minimal achievable final thickness is 0.23 millimeters.

EQUIPMENT MAXIMIZES FLEXIBILITY

The CCM® will be equipped with one pay-off and two reversing reels. Both rolling stands will be realized in four-high design. It will be possible to operate the mill with work roll sets of two different diameters. Excellent strip quality, high productivity and efficient rolling operations are provided by proven SMS group rolling technologies. A dry strip system per stand will be provided to remove surplus emulsion from

the strip surface. The plant will be equipped with the X-Shape flatness measuring and control system, which, together with multizone cooling, ensures optimal flatness results of the finished strip.

The CCM® will be operated with the X-Pact® automation package, which provides a consistent and complete system solution for the high-performance control concepts and strategies implemented by SMS group. In addition to the features aimed at optimizing plant efficiency, the TRC® (Total Roll Gap Control) assistance system developed by SMS group is going to be applied for automatic and stabilized strip threading into the pre-set optimized roll gap. The assistance system makes for stable rolling right from the strip head end, increasing the material yield as a result of reduced strip bulging at the head and tail ends.

The very high automation level of the CCM® is an important step towards digitalization and adaptability to future requirements. ♦

 **Jürgen Schanderl**
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Design concept of the Compact Cold Mill.

WORLDWIDE

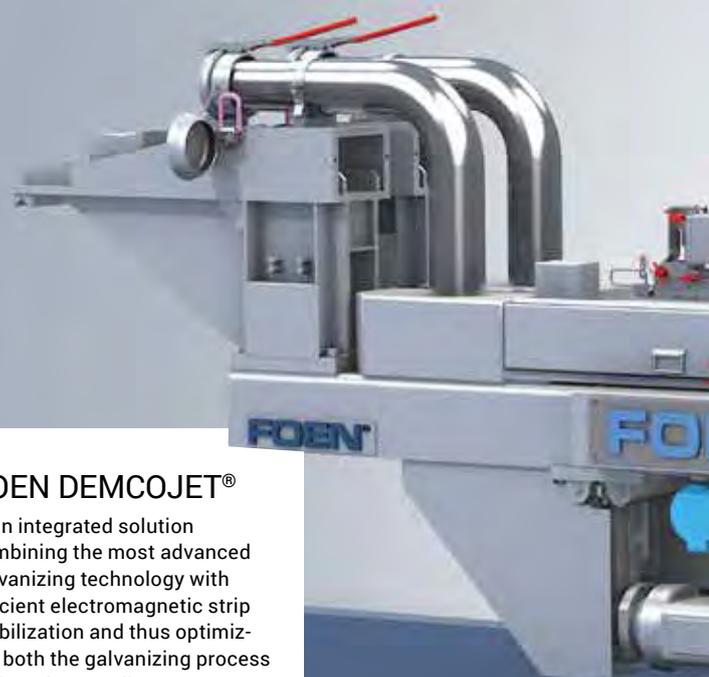
INTEGRATED STRIP STABILIZATION SYSTEM

With the aid of magnetic fields, FOEN DEMCOJET® reduces the distance between air knife and strip in galvanizing lines, and thus attains an optimum coating result.

FOEN® air knives rank among the most advanced air knife systems in hot-dip galvanizing lines for coating all steel grades used in the automotive industry which places the highest demands on surface quality. The first integrated solution combining air knife and strip stabilization system was the FOEN DEMCO® system. Due to changes in design and constant improvement, it was advanced to the FOEN DEMCOJET® system. Thanks to the very compact design, the distance between air knife and the stabilization point of the electromagnet could be reduced to about 500 millimeters providing the basis to achieve an optimum coating result. Up to now, twelve FOEN DEMCOJET® systems for galvanizing lines have already been sold. The system was installed at reputed steel companies like Tata Steel NL, US Steel Kosice and Salzgitter and will soon be supplied to voestalpine, US Steel Protec, Ternium Pesquera, Tata Steel UK, Stelco CA, Nucor, Hickman and CSN Galvasud. Further orders were awarded by HBIS Laoting for CGL 1 and 2.

Electromagnetic strip stabilization systems generally feature several electromagnets each nozzle arranged on both sides of the strip at the same height above the air knives. A position measuring sensor is installed below each magnet to continuously measure the distance of the magnet to the strip in a non-contact manner. The strip position determined by this sensor is compared to the target position. Through current variations in the coil it is possible to control the magnetic attraction acting on the steel strip and thus to equalize the strip profile and minimize strip movements.

Strip stabilization systems are a necessary feature in modern hot-dip galvanizing lines, since the requirements on process and surface quality are continuously growing due to various reasons. New industrial standards require closer tolerances, especially for the automotive industry. For example, the new European standard for the automotive industry (VDA 239-100) demands that the coil must not fall short of the minimum coating thickness value at no point. This makes the new standard stricter, since small deviations have a stronger impact on the evaluation. The trend towards higher-quality and more homogeneous surfaces requires a very stable strip run in the area of the air knives. For an economic



FOEN DEMCOJET®

is an integrated solution combining the most advanced galvanizing technology with efficient electromagnetic strip stabilization and thus optimizing both the galvanizing process and product quality.

production with a high yield of top-quality material, the processing speed must be as high as possible and cut-outs due to inferior quality after thickness changes are to be minimized. At the same time, resources should be saved to keep operational costs low. This objective can be achieved by a reduction of over-coating and by lowering the wiping pressure.

MINIMIZATION OF STRIP-TO-NOZZLE DISTANCE

The key issue of strip stabilization is a minimization of the distance between air knife and strip to use the jet core zone, since only in this zone there is a stable and homogeneous flow pattern without turbulence. A short distance will lead to many benefits for the galvanizing process and thus fulfill all aforementioned requirements. The main condition to be met is a stable strip run in the air knife area. Only then, the distance can be shortened systematically without the risk of scratching the strip surface and contaminating the nozzles. To make the strip running stably between the nozzles, three operating parameters have to be optimized: strip movements and vibrations must be reduced, the strip cross-bow be compensated, and the distance between strip stabilizer and nozzle gaps be minimized.

Operation results showed that with the FOEN DEMCOJET® it was possible to ensure a substantially improved and stabilized strip run. And the highly dynamic control system working with a response time of just one millisecond, effectively reduced strip vibrations by more than 50 percent. The FOEN DEMCOJET® magnets can be positioned by motor power and almost compensate and eliminate the strip cross-bow. This means, the main objective was reached and the mini-

imum distance between nozzle and strip shortened by at least three millimeters, which was sufficient to reach the jet core zone and ensure homogeneous coating.

The installation of the FOEN DEMCOJET® resulted in many benefits in terms of quality, productivity and operation. Coating uniformity improved, which led to lower zinc consumption. The yield of high-quality material was increased, since strip losses due to cut-outs at welds could be reduced significantly. Processing speed could be raised by up to 20 percent. In addition, it was possible to lower pressure which was accompanied by energy savings and a decrease in dross formation. Another benefit was the reduction of the correcting roll immersion depth. This went along with less wear of bath rolls and associated bearings.

PATENTED SYSTEM

Based on the operational experience, FOEN® is now continuously optimizing the DEMCOJET® system to further increase its performance. The technological lead is broadly protected by several international patents. ♦



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Further information

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Arranged in the entry section of SSAB's pickling line, the X-Pro laser welder with fiber laser connects even difficult-to-weld strips, fast and fully automatically.



Equipped with two payoff reels, the new entry section ensures a continuous feeding process.

FINLAND

FAST START-UP OF PRODUCTION

New entry section enhances capacity and cuts costs at SSAB.

In December 2018, the revamp project of the continuous pickling line at SSAB, Hämeenlinna Works, Finland, was successfully completed with the finalization of the second phase. The comprehensive revamp included a new entry section with X-Pro laser welder as well as a high-performance scale breaker, a horizontal looper and an extension of the pickling tank. All activities and services involved in the project, including supply of the complete electrical and automation equipment, were implemented by SMS group. SSAB was responsible for the civil work and overall erection.

High availability after each revamp phase

To make sure the line will have a fast ramp-up, the X-Pact® automation system was tested and optimized in advance in a Plug & Work integration test in Germany. As all necessary equipment was available on site within a short delivery period and SSAB had already finished the machine foundations, equipment installation could be started only eleven months after receipt of the order. The revamp actions had to be done within short downtimes, since the plant was expected to resume operation quickly. After the first step, the new equipment could be operated with an availability of 95 percent within six weeks. The ramp-up curve was even higher after the second step, so that four weeks later an availability of more than 98 percent could be achieved. Thus, all accep-



Christian Dornscheidt, Project Manager of SMS group, and Heikki Nisula, General Manager Investment Services at SSAB Europe, Hämeenlinna, Finland (from left to right).

tance tests were passed within the scheduled period of time.

Expanded product portfolio and reduced costs

"SSAB modernized the pickling line to be able to process the expanded product portfolio, which includes materials with yield points of up to 900 megapascals. Modernization also enables us to reduce costs," says Heikki Nisula, General Manager Investment Services at SSAB Europe, Hämeenlinna, Finland. ▶



The horizontal six-fold looper is capable of accumulating 410 meters of strip and allows a constant process speed of 180 meters per minute to be maintained while the coils are being welded together in the entry section.



The scale breaker is designed to process high-strength strips.

Two phases with ongoing production in between

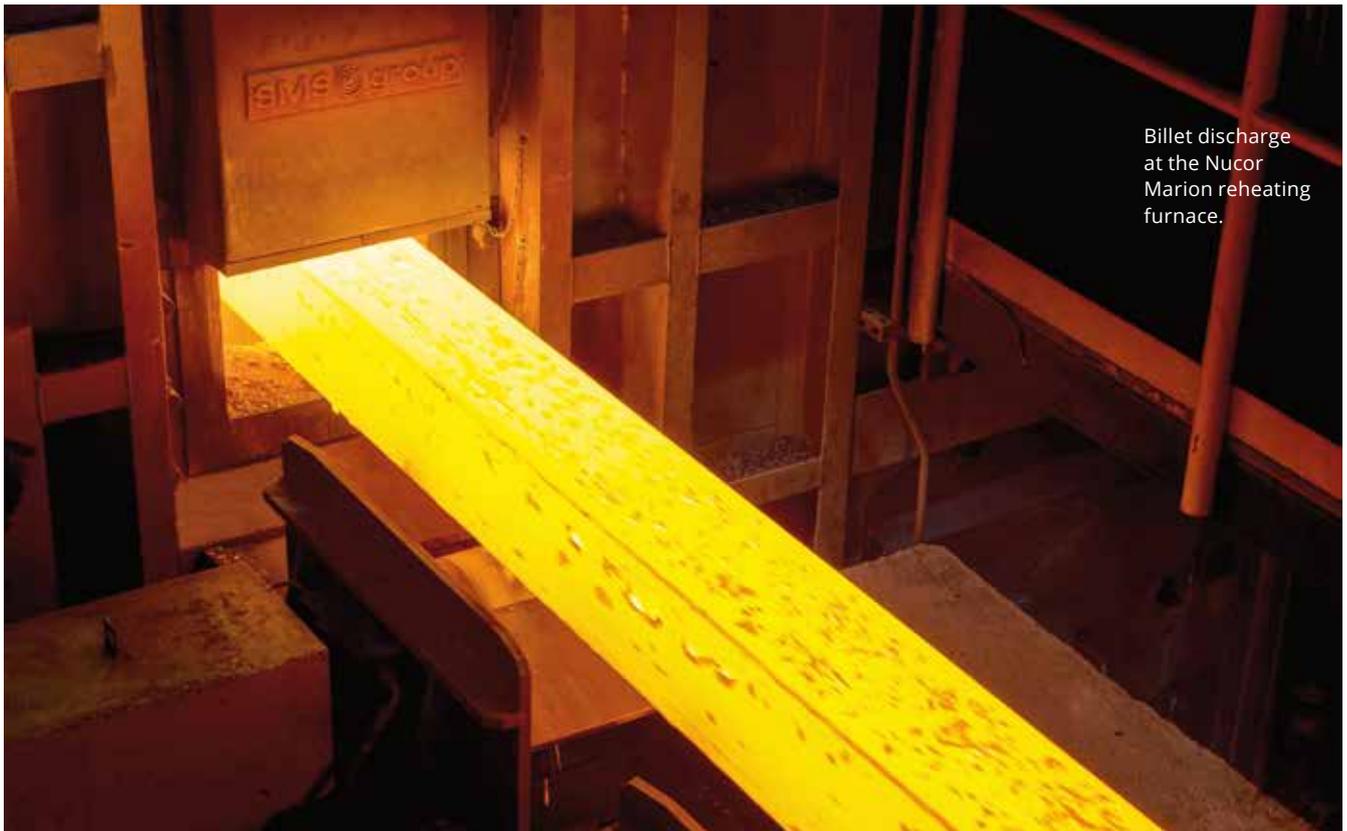
"The first phase of the modernization included a completely new entry section with two payoff reels, welding machine and looper," Christian Dornscheidt, Project Manager of SMS group, describes the scope. "We established the equipment in the open area in front of the existing pickling line during ongoing production and then connected it to the line during a one-week downtime." The second phase was completed at the end of 2018. "The existing entry section was dismantled at the beginning of July. On new foundations in that area, a newly developed scale breaker for high-strength material was installed and the pickling line expanded by a recuperator tank," Dornscheidt explains the comprehensive activities.

First fiber laser welder in operation now

In the first phase, special attention was paid to the X-Pro laser welder which is capable of welding steel strips with thicknesses between 1.5 and 6.5 millimeters and widths ranging from 650 to 1,650 millimeters to an endless strip in the entry section. The welder at the Hämeenlinna Works is the first one equipped with a solid-state laser, which means the laser beam is generated in a resonator by means of a laser-active fiber. The high efficiency combined with low maintenance costs cuts the operating expenses by up to 90 percent compared to conventional machines with carbon-dioxide laser source. Another reason for SSAB to decide in favor of an X-Pro laser welder was the fact that the new machine permits high-alloy steel grades to be welded. "We focus on high-strength steels, and these are often very difficult to weld because of their alloy compounds," adds Heikki Nisula and continues: "In 2015, we provided plates for welding tests at SMS group." ♦



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Billet discharge
at the Nucor
Marion reheating
furnace.

U.S.A.

MOST ENVIRONMENT-FRIENDLY REHEATING FURNACE

Nucor Marion commissions new walking beam furnace from SMS group.

Nucor Steel Marion Inc., based in Marion, Ohio, U.S.A., granted SMS group the Final Acceptance Certificate (FAC) for the supplied walking beam furnace shortly after successful commissioning. The reason for the quick acceptance by Nucor was that the guaranteed performance values could not only be achieved but were even exceeded by far. Nucor now operates the most energy-efficient furnace with the lowest emission values within the Nucor Group. The NO_x content of this furnace is close to 25 parts per million. The furnace was designed according to innovative pre-fabrication methods and features specially developed SMS ZEROFlame burners.

The furnace serves the existing bar mill and is capable of delivering 120 short tons (about 109 metric tons) per hour of hot billets at a temperature of 2,255 degrees Fahrenheit (1,235 degrees Celsius). For this purpose, it needs an energy of less than 1.04 million BTU (British Thermal Units) per ton.

Another remarkable fact is the savings in scale loss amounting to less than 0.5 percent in weight, compared to the 0.75 percent as guaranteed. This represents a very solid performance and a significant cost saving in the process. "We are proud of the results achieved by this furnace which sets new benchmarks in terms of reduced emissions in U.S.A. and particularly inside Nucor group," said Simone Zussino, Vice President Reheating Furnaces and Heat Treatments at SMS group S.p.A. This sentiment was shared by the Nucor Marion management, that congratulated the joint Nucor-SMS team on the good results on occasion of signing the FAC. ♦



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CHINA

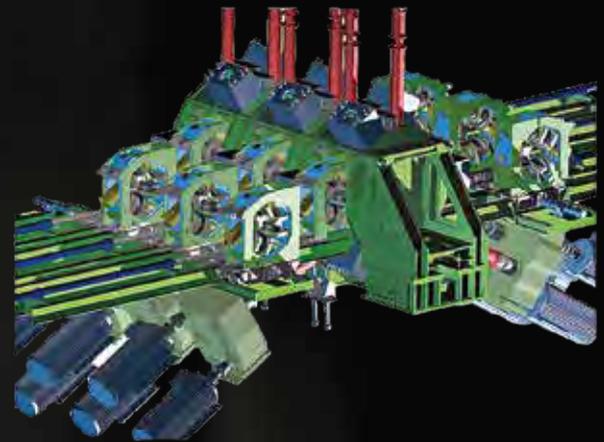
LEADING THE WAY WITH QUALITY AND PQF[®] TECHNOLOGY

ChangBao orders world's most advanced seamless tube plant.



CaliView[®] measuring system for inline calibration of the rolling mill and the passes.





Jiangsu ChangBao Precision Steel Tube Co., based in Changzhou in Jiangsu Province, China, has awarded SMS group the contract to supply a new, state-of-the-art PQF® (Premium Quality Finishing) seamless tube plant and related automation. Particular highlights of the scope of supply include various performance modules and a KR I 35/45 CNC groove dressing machine. This highly automated plant will enable ChangBao to meet the growing demand for precise, high-strength tubes for the local market.

The PQF® ordered will be used to produce tubes within a diameter range of up to 6 5/8 inches and wall thicknesses of between 4 and 20 millimeters. Its annual capacity is 300,000 tons of tubes. These are used in oil and gas production (OCTG tubes) and must satisfy very high quality and tolerance requirements in accordance with API standards.

USE OF STATE-OF-THE-ART PERFORMANCE MODULES

The order also includes the full automation of the machinery and plant sections, as well as state-of-the-art laser technology for measuring the wall thicknesses downstream of the PQF® and the stretch reducing mill (SRM). What's more, the CaliView® measuring system developed by SMS group allows for fast, inline calibration of all rolling mills, and so guarantees the perfect alignment of the mill line over a period of time. A networked, CNC-based groove dressing machine (KR) for high-precision machining of the SRM stands will also be supplied.

The use of LASUS® technology means the otherwise commonly applied radioactive isotope measuring technique can be replaced by a safe laser technology, which is extremely environmentally friendly to operate and ensures monitor control with PQF® SecControl technology® as well as front and tail end sharpening in real time with the FTS system.

Any yield losses are minimized using the latest modules in the CARTANEO technology system. The well-known functions CEC (crop end control for reducing thick ends), WTCA

BCO-TYPE PQF® PLANT

With the BCO-type PQF® plant (bilateral change-over), the stands are changed at both sides of the mill. The compact, easily accessible construction enhances the user-friendliness of the plant. The drive is simpler in design and is easier to service. In addition, the hydraulic capsules (hydraulic adjustment) are positively connected to the mill frame. This ensures the rolling forces are distributed symmetrically over the mill, resulting in a further significant improvement in wall thickness variations. This increases both the efficiency and flexibility of the mill.

(average wall thickness control), and WTCL (local wall thickness control) have been significantly improved thanks to self-learning algorithms (artificial intelligence, or 'AI').

ULTRA-MODERN, STABLE TUBE PRODUCTION

With this investment ChangBao is banking on ultra-modern, highly stable tube production. The lower material stress allows the product range to be extended to include even thinner-walled dimensions and higher-alloy steel grades. The high level of digitalization of all equipment was what convinced the customer to be well equipped for the future. The new seamless tube plant is scheduled to be commissioned in the first quarter of 2020. ♦



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The participants of a one-week technology training course.

ITALY

A CLOSE PARTNERSHIP – FROM IDEA TO FINISHED TUBE

An international team of rolling mill experts from Vallourec – the worldwide market leader in premium tube and pipe solutions – visited SMS group for a one-week technology training course.

Vallourec is a worldwide market leader in premium tube and pipe solutions for both the energy sector and industrial applications. Its products and services are employed in challenging oil and gas drilling operations, in the latest generation of power stations, in ambitious architectural projects, and in high-performance plant and machinery.

Such premium products can only be manufactured on high-end equipment, which is why Vallourec has been relying on the expertise of SMS group for many years now. Around the world Vallourec operates three PQF® (Premium Quality Finishing) seamless tube plants

from SMS group: one in Brazil (16 inches), and the others in China (10 ¾ inches) and Germany (4 inches). The company has also been operating plug mills and continuous rolling mills for years and invests in upgrades and performance modules to ensure consistently high quality for demanding applications.

In October 2018, both companies went a step further in the expansion of their close partnership: an international team of rolling mill experts from Vallourec's tube and pipe production facilities visited SMS group at its Milan site for a one-week technology training course.

Over the course of the week SMS group focused, among other things, on the subjects of innovation and improvement, and presented the latest developments in mechanical design, process automation and process technology, while participants from Vallourec had the opportunity of giving important feedback on the operation of their plant and equipment. The topics discussed in detail ranged from the CARTA technology system, through the mathematical model for the PQF® setup, right up to hydraulic and mechanical systems.

CONSTRUCTIVE COOPERATION

Jean Luc Lambert, Hot Rolling Process Director at Vallourec, sums up the productive and successful collaboration between the two companies: "On behalf of the whole Vallourec team I would like to express my sincere thanks for this training, which enables us to achieve an even higher level of expertise in our plants and facilities."

In order to intensify cooperation on joint research projects, Vallourec invited SMS group to the Vallourec Competence Center in Riesa. The 4-inches PQF® mill supplied by SMS group is part of the "Vallourec Competence Center" and is at the same time a cornerstone of important research projects. Pilot trials can be carried out on an area covering approximately 2,500 square meters, without having to halt production. The Competence Center conducts a wide variety of tests relating to new steel grades, the optimization of rolling processes and tool service lives, and thus makes a successful contribution within the Vallourec group. Vallourec and SMS group are able to intensify their collaboration and work together on new research projects. In this way, both partners benefit from the testing and evaluation of a host of new and innovative ideas and solutions, which may well have a positive effect on seamless tube production in the near future. ♦



4-inches PQF® plant at German Riesa site.



16-inches PQF® plant at Brazilian site.



CHINA

FUZHOU WUZHANG STEEL ORDERS TMbaR MILL

Production of fine-grained rebars by
thermomechanical rolling.

Fuzhou Wuzhang, China, has placed an order with SMS group to upgrade its existing mill with the TMbaR technology for thermomechanical rolling of rebars. This is the third order for a TMbaR mill in China within one year, right after Yancheng Lianxin Steel and Laigang Yongfeng Steel placed their orders.

Fuzhou Wuzhang, located in the Changle District of Fuzhou, focuses on the economic and efficient production of structural steel products. It has an annual capacity of about two million tons.

The new line will be designed for an annual production of 700,000 tons of rebar in diameters ranging between 10 and 18 millimeters at a maximum rolling speed of 45 meters per

second and the possibility to produce rounds in the 14 to 20 millimeter range. SMS group will supply all key equipment including the electrics and the automation package. The plant is scheduled to go on stream in mid-2019.

THERMOMECHANICAL ROLLING

Fuzhou Wuzhang chose SMS group's TMbaR technology in order to be able to respond to the ever increasing quality requirements in the market while cutting production costs. Technological highlights of the equipment to be supplied are the well proven loop technology which allows achieving



The SMS HSD® system in operation at Luoyuan Mingguang, near Fuzhou Wuhang.

The new line will be designed for an annual production of 700,000 tons of rebar in diameters ranging from 10 to 18 millimeters at a maximum rolling speed of 45 meters per second.

an ideal temperature across the feeder section within an optimized mill bay length, and SMS group's MEERdrive® finishing blocks. The single drive concept of these blocks provides utmost technological and economic benefits over other drive concepts in terms of overall processing costs. The robust cartridge-type design makes for consistently high performance with minimized maintenance requirements. The equipment has been specially designed for long rolling campaigns under the high rolling load demanded by the TMbaR process. In combination with the state-of-the-art High-Speed Delivery (HSD®) system, the TMbaR technology offers exceptional technological and economical benefits which have convinced Fuzhou Wuhang to place this order with SMS group.

LONG-LASTING EXPERIENCE FOR THE PRODUCTION OF STRUCTURAL STEEL PRODUCTS

By putting its trust in the long-standing experience of SMS group and in the advanced TMbaR technology, Fuzhou Wuhang is expanding the cooperation between Wuhang and SMS group and will be able to respond better and faster to market demands, achieve improved material properties and save on alloys and operating costs. ♦



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From left to right:
Filippo Verlezza,
Area Sales Manager,
SMS group S.p.A.;
Vittorio Valotti,
Rolling Mill Director
Technical Depart-
ment Feralpi Group,
Lonato works; Nicola
Redolfi, Sales
Director, SMS group
S.p.A.; and Maurizio
Fusato, Plant
Manager Feralpi
Group, Lonato
works.



EBROS system during welding process used in production.

ITALY

ENDLESS ROLLING AT LONATO WIRE ROD MILL

Feralpi Group orders EBROS billet welding system.

Feralpi Siderurgica S.p.A. has placed an order with SMS group for the supply and installation of the EBROS welding technology at its Lonato plant in Brescia, Italy.

The EBROS billet welding system is used to weld together the hot billets as they come out of the reheating furnace. This process makes "endless rolling" possible, offering a considerable increase in productivity, material yield and plant utilization as well as guaranteeing a consistently high product quality.

INCREASE OF PLANT PRODUCTIVITY BY UP TO EIGHT PERCENT

Implementing EBROS in the existing wire rod mill may increase Feralpi's plant productivity by up to approximately eight percent. Furthermore, cobbles, and head and tail end cropping can be eliminated improving the product yield by at least three percent.

The latest system, which comes with an advanced transformer solution to yet better control the welding operations, includes an easier cleaning system, reduces maintenance and sparks and provides efficient deburring with a collecting bucket and a quick change system. A two-megawatt induc-

tion furnace supplied by SMS Elotherm, a company of SMS group, will be included in the supply to ensure billet temperature equalization at the entry into stand No. 1 in order to keep the rolling temperatures within the correct range and enhance final product tolerances. The welding machine will make full use of the furnace capacity of 130 tons per hour and is capable of welding together billets up to 150 millimeters square and 12 meters length.

COMMISSIONING OF THIS PLANT IS SCHEDULED FOR THE FIRST QUARTER OF 2020.

This latest order sets the score to ten EBROS units supplied by SMS group worldwide, and it further underlines SMS group's expertise and position as a leading partner in the world of metals – having installed already 543 rolling mills for wire rod, SBQ and special applications, bars and merchant products since 1950. ♦



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ITALY

SUCCESSFUL INTEGRATION INTO EXISTING EQUIPMENT

Arlenico starts production of quality wire rod with MEERdrive®PLUS block from SMS group.

Arlenico, a special quality wire rod producer located near Lake Como, has put the new four-stand MEERdrive®PLUS sizing block supplied by SMS group into operation in the existing Caleotto wire rod line in Lecco, Italy. Arlenico is now able to serve the market with products of much tighter tolerances than produced ever before. Thanks to the technologies supplied by SMS group, including a high-tech water cooling line of the latest design and the level 2 automation system, the company can now also apply thermomechanical rolling.

Already in December 2018, Arlenico officially issued the preliminary acceptance certificate, followed by performance tests on the production of wire rod in diameters from 5.5 up to 27 millimeters in several steel grades at the maximum speed of 115 meters per second, and at low temperatures of 750 °C during

MEERdrive®PLUS is a variant of the MEERdrive® technology, a revolutionary drive concept for modern wire rod production. It uses individual drives with small low-voltage motors for each stand. Since all finished sizes are rolled in the MEERdrive®PLUS block, it is possible to realize "one-family rolling" in the rolling mill considerably reducing the otherwise required mill downtimes for size and ring changing.

The SMS group MEERdrive®PLUS sizing block in operation at ARLENICO works.



THERMOMECHANICAL ROLLING

Thermomechanical rolling is a forming process in which final reduction is carried out within a defined temperature range leading to specific properties of the rolled stock. Thus, sufficient capacity for cooling and equalization has to be provided for in the plant design. The lower rolling temperatures (750 to 820 degrees Celsius) require higher rolling forces and consequently wire rod blocks capable of sustaining very high loads. Under these rolling conditions, grain sizes that in conventional rolling would typically range between ASTM 8 and 10 can be improved to ASTM 12 with thermomechanical rolling.

the following months. Since the first rolling trials, the tolerances as low as 0.05 millimeters and 50 percent ovality have been fully met on 5.5 millimeter diameter wire rod. ♦



Contact

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INDIA

MEETING ALL MARKET REQUIREMENTS

Mukand Sumi Special Steel orders SBQ mill.

MSSSL receives a comparable three-roll precision sizing block (PSM®).

SBQ BAR STEEL

Typical applications for SBQ bars (Special Bar Quality) can be found in the automotive and mechanical engineering industries. The closest tolerances and maximum consistency are what is needed here – and competition is intense, especially among sub-suppliers. With bar mills from SMS group, rolling mill operators can meet all their customers' needs, both flexibly and efficiently – giving them a real competitive advantage.

PSM®

The 3-roll PSM® (Precision Sizing Mill) technology from SMS group is a high-precision and flexible solution for the finish-rolling of bars and a core element of a high quality SBQ mill. One of its outstanding principal features is its capability to adjust each roll under load – fully automated and in real time. With the PSM® one family rolling in the roughing and intermediate mill as well as the infinitely variable production of all finishing sizes by using the free size range is possible.



From left to right: Sushant Patro, Vice President, Head of Business Unit Long Products, SMS India; A. M. Kulkarni, Director, MSSSL; Prasad Menon, Chief, Manufacturing & Operations, Steel Division, Mukand Ltd.; O. P. Singh, Chief of Projects, MSSSL; Ulrich Svejkovsky, Vice President Sales, Long Products, SMS group; Alexander Schander, Sales Manager, Bar and Wire Rod Mills, SMS group; Pradip K Ghosh, Director Sales, Long Products, SMS India; Sarit Dutta, Associate Vice President, Department Head Commercial Sales, SMS India.

Mukand Sumi Special Steel Ltd. (MSSSL), a joint venture of Mukand Ltd., India, and Sumitomo Corporation, Japan, has placed an order with SMS group for the supply of a state-of-the-art Special Bar Quality (SBQ) rolling mill for the production of straight round and hexagon bars, wire rod and bar-in-coils. The new mill will be installed near Hospet in Karnataka, India, adjoining Mukand's existing steel making facilities. Mukand and Sumitomo Corporation are aiming to export specialty steels across the globe from this unit.

PLANNED CAPACITY EXPANSION

In a first stage, the mill will have an annual capacity of 400,000 tons, but will already be prepared for a capacity increase to 600,000 tons per year in a second stage.

The mill will comprise a walking-beam reheating furnace with a capacity of 75 tons per hour in the first stage and 110 tons per hour in a second stage, 18 housingless two-high stands in H/V arrangement, a Precision Sizing Mill (PSM[®]), shears, cooling lines, cooling bed with finishing facilities, a wire rod line with a ten-stand wire rod block, laying head, Loop Cooling Conveyor (LCC[®]), coil handling equipment and a coil compactor. A reeling line with two coilers specially designed for scratch-free guiding of finished products will complete the mill.

The heart of the mill is an advanced three-roll PSM[®] with hydraulic roll adjustment under load. All finished sizes with diameters ranging from 17 to 65 millimeters can be produced cost-effectively even in small batches at a maximum speed of 14 meters per second.

Wire rod in diameters from 5.5 to 22 millimeters will be produced on the wire rod block at a maximum speed of 90 meters per second. The layout of the wire rod outlet will also consider a future upgrade with a MEERdrive^{®PLUS} sizing block. Commissioning of the new SBQ mill is scheduled for the second quarter of 2020. ♦



Contact

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“With this new mill, we will be able to expand our position as a leading specialty steel supplier for the fast-growing Indian and worldwide automotive and engineering industries.”

Arvind M. Kulkarni, Director at Mukand Sumi Special Steel Ltd.

COLOMBIA

VCC® TECHNOLOGY CONQUERS SOUTH AMERICAN MARKET

Ternium Barranquilla orders VCC® line.

Ternium del Atlántico SAS has placed an order with SMS group for the supply and installation of the VCC® technology (Vertical Compact Coiler) for its bar mill in Palmar de Varela, Barranquilla, Colombia.

SMS group's VCC® is today's state-of-the-art solution for producing compact and torsion-free coils, and is now increasingly in demand by rebar processors. The compact coil is a crucial step forward in improving the packaging quality of the final product. These coils have preselected dimensions that, thanks to VCC®, remain consistent for all products processed

on the same line. At the same time, the compact coil size is ideal for storage, transport and handling. This is particularly beneficial when coils are reworked next to construction sites, where there is a build-up of rebar stirrups and other concrete reinforcing structures, especially in metropolitan areas with many space constraints. These advantages convinced Ternium to integrate this VCC® technology into the existing bar mill.

Once in operation, the plant will produce rebars from eight to 16 millimeters in diameter at speeds of up to 35 meters per second. The output will be 120 tons per hour with a coil weight of up to three tons.

One of the most important features of VCC® is its method of coiling the bar directly in the vertical position. Plant operators can therefore eliminate the need for turning manipulators and at the same time reduce the process cycle time, as all coils are formed in the final position. The coils are ready to be stored immediately once coiling has been completed and the coils have cooled down.

This order sets the score to 20 VCC® units supplied by SMS group worldwide since 1998 and is another important achievement demonstrating again SMS group's expertise and position as a reliable and leading partner in the world of metals for plant supply, installation, startup and commissioning. The result is 543 facilities for wire rod, SBQ and special applications, bars and merchant products the company has supplied since 1950. ♦

VERTICAL COMPACT COILER (VCC®)

The VCC® features spooling technology developed by SMS group for producing compact coils consisting of rebars, rounds, squares and hexagons. The geometry assures smooth de-coiling during the downstream process. SMS group's VCC® produces coils with weights of up to 5,000 kilograms.



From left to right: Filippo Verlezza, Area Sales Manager, SMS group; Norberto Gonzales, Project Manager, Ternium.



Direct coiling in vertical position.



Contact

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Stahlwerk Thüringen's product range at its Unterwellenborn facilities includes heavy and large sections.

Photo: Stahlwerk Thüringen GmbH



GERMANY

HIGH FLEXIBILITY AND PRODUCTIVITY THROUGH REBUILD

Stahlwerk Thüringen upgrades section mill.

Stahlwerk Thüringen GmbH, a company of Brazilian Grupo CSN, has awarded SMS group the order to supply a new CCS® (Compact Cartridge Stand) universal stand U1 for its section mill in Unterwellenborn, Germany.

The new CCS® stand is to replace the existing U1 stand in operation since 2002 as breakdown stand for the three-stand CCS® tandem group. This upgrade has become necessary as a result of the continuously growing range of sections produced, especially to include increasingly heavier and larger section sizes.

The new stand will be designed for a nominal rolling force of 6,000 kN horizontal and 4,000 kN vertical (maximal 9,400 kN and 6,800 kN respectively). It will come with stronger roll guides and optimized roll cooling.

The scope of the modernization also comprises the new supply of the Technological Control System (TCS) for the com-

plete CCS® tandem group and adaptation of the existing control systems. The TCS will be based on SMS group's proven X-Pact® automation system. In addition to the upgrade of the hardware and the system software, the I/O level for the U1 will be newly set up. Last but not least, all screwdown systems will be controlled by a newly developed dynamic optimization system, which will directly result in optimized reversing times and higher productivity of the tandem group as a whole. Commissioning is slated to take place in August 2019. ♦



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LONG PRODUCTS



CZECH REPUBLIC

MODERNIZATION SECURES FUTURE

Třinecké železárny grants Final Acceptance Certificate to SMS group for upgraded blooming mill stand.

Following the commissioning of its new blooming mill stand, the Czech steel company Třinecké železárny has granted the Final Acceptance Certificate (FAC) to SMS group.

MODERNIZATION FOR INCREASED PROCESS RELIABILITY

The objectives of the upgrade were to maintain and ensure the operational reliability and plant availability, to create the necessary process stability and to improve quality, tolerances and yield. Due to the advanced age of the plant this upgrade was an essential investment into the future of Třinecké železárny.

The scope of the upgrade included a new rigid two-high reversing blooming mill stand with shifting and tilting device. The blooming mill is used for the preshaping of intermediates – also of high-alloy steels – made from

TŘINECKÉ ŽELEZÁRNY

is part of the Moravia Steel Group and has a broad product portfolio: rails, wire rod, bar steel including SBQ, seamless tubes, and drawn steel.

continuously cast material up to 525 millimeters in diameter and ingots up to a weight of 5.3 tons. Moreover, it is also providing the feedstock material for the existing rail, bar and wire rod production at Třinecké železárny, which shows the importance of this critical modernization project. Another core element of this order is the new hydraulic bloom shear with a shear force of around 1,000 tons. The shear is driven by an innovative and energy-efficient variable-speed pump (VSP). ♦

The new, two-high reversing blooming mill stand with shifting and tilting device for Třinecké železárny.



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SOUTH KOREA

HORIZONTAL ROLLER STRAIGHTENER PUT INTO SERVICE

Improved product quality for the automotive, shipbuilding and construction industries.



Installation work for new horizontal roller straightener of Korean Hyundai Steel.

Korean Hyundai Steel has granted SMS group the Final Acceptance Certificate after successful commissioning of a new straightening machine for the medium section mill at its Incheon site, South Korea.

The new horizontal roller straightener replaces an existing straightener installed in 1995. With this new horizontal roller straightener, Hyundai Steel is able to roll larger sheet piles and beams up to a web height of 450 millimeters. In addition to extending the product range, the straightener helps to improve the tolerances and quality of the sections. This straightener type impresses also with reduced maintenance and lower media consumption while maintaining a high level of process reliability. ♦

 **Contact**
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FAC received within only six weeks after shutdown.



From left to right: Austin Pitzer, Controller, NYS; Waldemar Vogel, Sales Engineer, SMS group; Jason Ciepiela, Mill Maintenance Supervisor, NYS; Chris Ziegler, Roll Shop Supervisor, NYS; Thomas Maßmann, Vice President Section and Billet Mills, SMS group; Thad Solomon, Vice President and General Manager, NYS; Jim Shelton, Rolling Mill Manager, NYS; Mario Fabro, Long Product Sales Manager, SMS group and Dirk Köhler, E&A Process Engineer, SMS group.

U.S.A.

NUCOR-YAMATO OVERHAULS ROLLING MILL NO. 2

Expansion of production capabilities, even for new high-strength steel grades.

Nucor-Yamato Steel Company (NYS) has selected SMS group for the replacement and upgrade of rolling equipment at their heavy section mill in Blytheville, Arkansas, USA. NYS is comprised of two rolling facilities commonly referred to as Mill 1 and Mill 2, capable of producing an annual capacity of

2.4 million tons of finished product. SMS group will upgrade Mill 2, which produces wide-flange and H-beams. The core of the upgrade is the substitution of the UR-E and UF stands with a modern tandem-reversing mill type CCS® 1500.

Thomas Maßmann, Vice President Section and Billet Mills of SMS group said, "This project further strengthens the cooperation between our two companies following the successful outcome on the earlier upgrade project SMS completed on Mill 1."

SMS group will supply the mechanical equipment and the mill control automation. The startup of the new tandem reversing mill is planned for the second half of 2020. ♦

"We are committed to growing our market leadership position in structural steel and this project advances that goal."

Thad Solomon, Vice President and General Manager of Nucor-Yamato Steel.

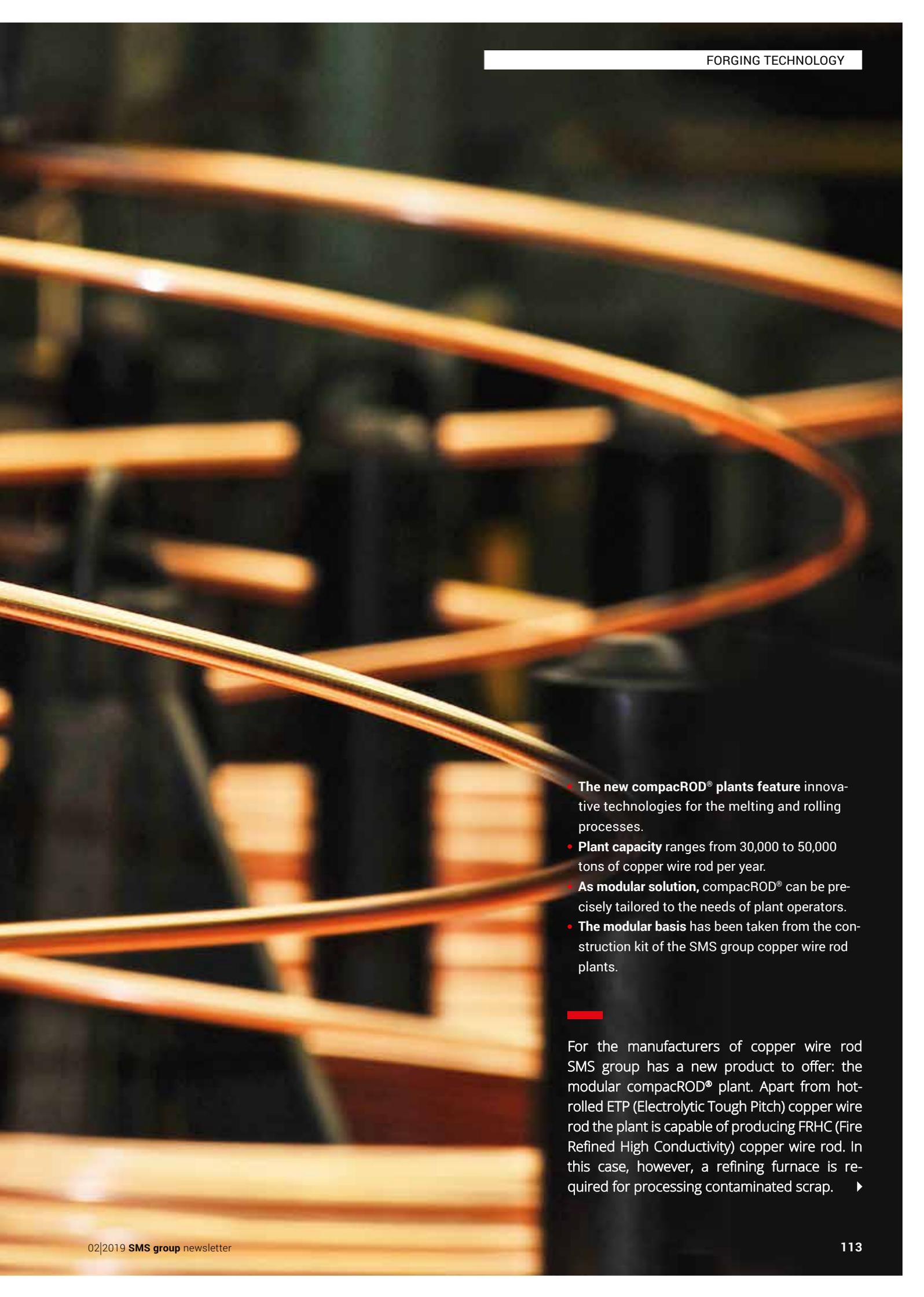


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WORLDWIDE

COMPACT, BUT IMPRESSIVE

With the modular compacROD® plant, SMS group offers a cost-effective solution for the production of high-quality copper wire rod. Plant operators benefit from top product quality and low production costs.

- 
- **The new compacROD® plants feature** innovative technologies for the melting and rolling processes.
 - **Plant capacity** ranges from 30,000 to 50,000 tons of copper wire rod per year.
 - **As modular solution**, compacROD® can be precisely tailored to the needs of plant operators.
 - **The modular basis** has been taken from the construction kit of the SMS group copper wire rod plants.

For the manufacturers of copper wire rod SMS group has a new product to offer: the modular compacROD® plant. Apart from hot-rolled ETP (Electrolytic Tough Pitch) copper wire rod the plant is capable of producing FRHC (Fire Refined High Conductivity) copper wire rod. In this case, however, a refining furnace is required for processing contaminated scrap. ▶

HIGH EFFICIENCY THANKS TO SMART HEAT UTILIZATION

To ensure that processing costs are low while consistently maintaining high quality for the compacROD® plant, SMS group relies on its many years of experience and state-of-the-art technologies for the melting and rolling processes. The shaft furnace from SMS group, for example, stands out for its exceptional efficiency due to its special design principle; with the effect that less energy is needed when feed material is melted.

The vertical furnace vessel is filled with cathodes for the melting process. A special charging system enables the cathodes to be loosely distributed. Gas burners are fitted in rows in the lower part of the furnace, and these are used to melt the copper. The hot offgases which rise up during this process are almost fully utilized in the upper furnace zone to heat up the charged material.

The effective use of thermal energy provides for high efficiency – in particular when compared to other melting processes. Another feature is the automatic burner control, which allows each burner to be regulated separately via the electronic Lambda control system. The “nozzle mix principle” applied here guarantees a high level of safety and creates uniform combustion conditions with low, stable oxygen content in the molten copper. The compacROD® plant can also be equipped with an induction furnace as melting unit, so that electrical energy is used if there is no natural gas or LPG gas available on site.

MODULAR ROLLING MILL WITH INDIVIDUAL FREQUENCY- CONTROLLED DRIVES

The modular rolling line consists of several mill stands, all of which have the same design. Each mill stand features two roll rings and the roll gap is adjusted via a central spindle. The benefit: a centralized synchronous adjustment of both rolls ensures that a long service life is achieved.

In addition to that, the roll gap can be adjusted significantly faster and more precisely. Individual frequency-controlled drives considerably reduce the consumption of electrical energy enabling individual speed adjustment.

The fact that all stands feature the same design also has a positive effect on maintenance activities. Despite fewer spare parts on stock, the availability of the rolls is maximized. The roll rings can also be changed quite simply with just a few steps. Costly, time-consuming workshop activities, like with three-roll stands, are avoided. It goes without saying, that the compacROD® is also available with additional inline measurement devices and coil handling systems individually tailored to the needs of the customer. ♦



Thomas Schatz
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FEATURES OF COMPACROD® - COPPER WIRE ROD PLANT

- Cost-effective production with low process costs
- Modular configuration for customized solutions
- Highly efficient shaft furnace with cathode preheating system
- Advanced burner technology with Lambda control system on the shaft furnace
- Continuous production of the cast ingot using the wheel and belt method
- High-end rolling mill with separate individual drives
- Continuous use of frequency-controlled drives for enhanced efficiency
- Cooling and coiling equipment for high quality standards

COMPACT COPPER WIRE ROD PLANT FOR TOP PRODUCT QUALITY AND LOW PROCESS COSTS

1. Shaft furnace

Previously charged feed material is melted in the gas-fired shaft furnace into liquid copper in an energy-efficient manner. Should no natural or LPG gas be available at the installation site the plant can also be equipped with an induction furnace.

2. Cathode

3. Charging device

4. Holding furnace

5. Two-wheel caster

Liquid copper flows from the furnace to the two-wheel caster via launders forming a cast ingot. The plant is capable of processing five to seven tons of copper, per hour.

6. Cast ingot preparation

In the ingot preparation zone the cast ingot is prepared for the rolling process.

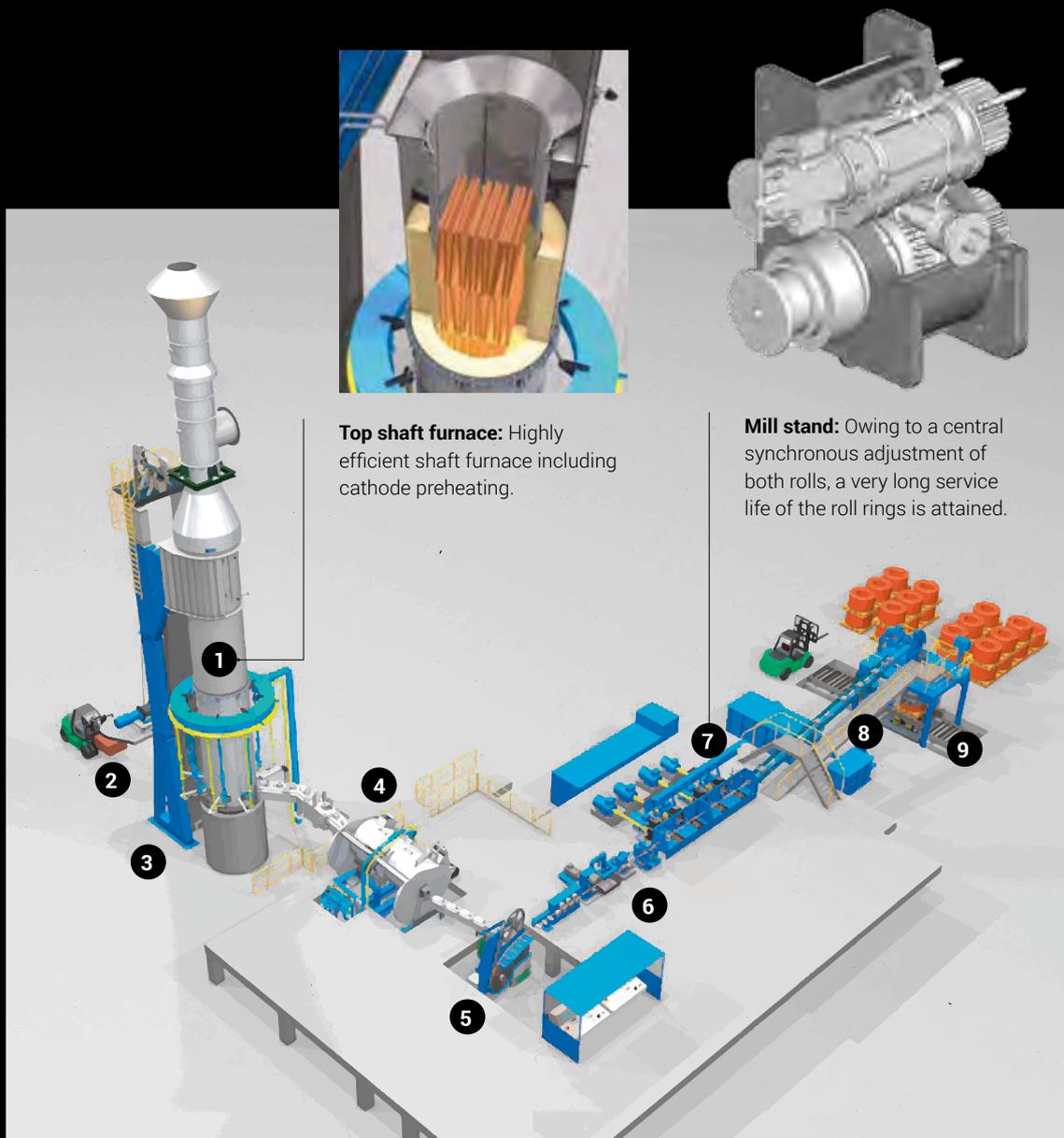
7. Rolling mill

8. Cooling line

While the wire rod is still hot, it is deoxidized in the cooling section and then cooled down. Immediately after that, wax is applied to the wire rod surface for preservation.

9. Coiler

In the coiler the wire rod is coiled with a unit weight of three to five tons.



CHINA

EXPANSION OF PRODUCT RANGE

Daye Special Steel orders hydraulic open-die forging press from SMS group.

Chinese steel and forging company Daye Special Steel Co., Ltd., based in Huangshi City, Hubei Province, has awarded SMS group the contract for the engineering and delivery of a 50/60 MN, high-speed hydraulic open-die forging press. Once again, the customer is placing its confidence in forging

press technology from SMS group: Daye has been using an SMX 800/16 MN radial forging machine, supplied by SMS group, since 2011.

The open-die forging press operates with a forging force of up to 50 MN and an upsetting force of 60 MN. Daye opted for the stable, four-column push-down press with moving crosshead. The high forging frequency of the press not only enables sophisticated materials requiring a narrow temperature range to be forged, it also reduces machining times. During planishing, the new press is capable of reaching a frequency of 103 strokes per minute. Daye Special Steel plans to use the new open-die press to forge a variety of products of high-temperature alloys and special steel.

CUSTOMIZABLE OPERATING MODES

This open-die forging press to be provided by SMS group to Daye Special Steel can be operated in fully automatic, semi-automatic, or manual mode. Daye Special Steel will be able to forge materials extremely precisely and energy-efficiently in program mode, using pass schedules that are precalculated with the ForgeBase® forging program. In addition, the press will feature a press control and visualization system, which was developed by SMS group and will allow Daye Special Steel to attain maximum reproducible product quality with a forging tolerance of around ± 1 millimeter.

For fast die changes the machine will be equipped with a forging die changing device. The open-die forging press is to be installed in the Huangshi plant. Commissioning is scheduled for May 2020. ♦



An identically designed open-die forging press from SMS group in operation.

 **Dr. Serdar Tuncel**
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50/55-MN open-die forging press of two-column, push-down design with fitted X-Forging Box.

CHINA

HIGHER QUALITY AT LOWER PRODUCTION COSTS

Sichuan Liuhe Forging orders high-speed open-die forging press with innovative X-Forging Box radial forging tool from SMS group.

Sichuan Liuhe Forging Co., Ltd., based in Jiangyou in the province of Sichuan, China, has placed an order with SMS group to supply a high-speed, 50/55 MN open-die forging press. The press is of the two-column, push-down design and features a table shifter and die shifting unit. The open-die forging press operates with a press force of up to 50 MN and a maximum upsetting force of 55 MN. The press is suited for forging high-quality products with finished dimensions within the close tolerance range of ± 1 millimeters.

Sichuan Liuhe Forging is a specialist manufacturer of forged semi-finished products, reinforcing rings, shafts, parts for turbine blades, and supercritical components for gas turbines made of high-temperature, corrosion-resistant special steel and superalloys. The new press allows Sichuan Liuhe Forging to continue to offer a consistently high level of product quality to its customers in the aerospace industry and to operators of large-scale steam turbines.

“With this investment in the open-die forging press, developed and built by SMS group in Germany, we are raising our quality standards to an even higher level,” says Hong Yuchun, Vice-General Manager of Sichuan Liuhe Forging.

“We are also pleased that the enhanced press control system will mean lower production costs for us.”

The order also includes an XFB (X-Forging Box) 650/50 MN, which is a newly developed radial forging tool for open-die forging presses. The XFB transforms the movement of the top tool in the open-die forging press into a radial movement of the four tools in the X-Forging Box. At the same time, the maximum permissible force of 50 MN is evenly distributed among the four tools. The maximum initial pass section is 650 millimeters. The X-Forging Box is capable of forging a wide range of high-quality round products with variable cross-sections. The use of the XFB enables Liuhe Forging to expand its product mix and quickly change between different types of products; no modifications to the tool chamber or to the hydraulic-electrical connections are required to install an XFB. Commissioning of the 50/55-MN open-die forging press and 650/50-MN X-Forging Box is scheduled for Q4 2019. ♦



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CHINA

FULLY AUTOMATED, PRECISE AND HIGHLY EFFICIENT

Dongfeng Forging orders 5,000-ton
eccentric forging press from SMS group.





SMS group's MP 5000 eccentric forging press for Dongfeng Forging.

Dongfeng Forging Co., Ltd., part of the commercial vehicle manufacturer Dongfeng Motor Group, has placed an order with SMS group for the supply of an MP 5000 eccentric forging press with a forging force of 5,000 tons for its plant in Shiyan, Hubei Province, China. Founded in Shiyan in 1969, Dongfeng Forging Co., Ltd. operates a total of 26 forging lines at this site including, among others, a 12,000-ton wedge press supplied by SMS group.

Dongfeng Forging intends to use the new forging press to manufacture light-truck crankshafts with a maximum finished part weight of 21.5 kilograms. The new eccentric press will forge parts precisely, highly efficiently, and fully automatically with a nominal forging force of 50 MN. In addition to the press, the scope of supply includes process development services, sequence-controlled loading and unloading belt conveyors, an electrically operated automatic walking beam for parts handling, and an integrated die spraying system. Also, SMS group will supply a line control system for connecting other equipment units as, for example, the heating system.

The MP 5000 is one of SMS group's advanced series of eccentric forging presses. Extremely large press windows in the FEM-optimized press housing offer a perfect automation capability and allow for easier changes of die and die holder.

EXTENSIVE REDESIGN

SMS group is continuously working on the optimization of its plants and equipment. And this is why the MP series, too, was extensively redesigned. Numerous different improvements were made to reduce the labor and costs involved in maintenance and inspection work. This primarily includes the use of an almost maintenance-free, low-noise electrohydraulic coupling and brake. The hydraulic single ejectors in the table and ram can be individually operated for each forming station. In addition, the ram adjustment device that, in automatic mode, enables a ram adjustment of 0.1 millimeters between two strokes was improved on the drive side.

Commissioning of the new MP 5000 closed-die forging press is scheduled for the second quarter of 2020. ♦

Dongfeng Forging plans to use the MP 5000 from SMS group to forge crankshafts.



Bernhard Kaminski
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Closed-die forging press with 3D spraying system. By using iForge die maintenance can be carried out more efficiently.



WORLDWIDE

IFORGE – CLOSED-DIE FORGING PLANTS OF THE FUTURE

With the smart, digital solution iForge the forging press keeps learning with each impact. iForge is the result of numerous developments and innovations of SMS group.

- **iForge collects data** for quality assurance, optimization and productivity increase. These not only help with the development of new products, but also with the initial programming of new plants.
- **In the future, sensors and cameras** will be able to ensure that machines automatically make intelligent decisions based on data and high-resolution images.

Forged steel parts will continue to play an important role in future because they are indispensable when it comes to safety-relevant and at the same time economic components which have to withstand high stresses. However, in order to increase quality, efficiency and competitiveness, the operators of forging plants are forced to employ new digital technologies. iForge from SMS group is an elementary step for forging plants into the digital future.

The new iForge

iForge is considered a smart, digital solution which makes the forging press learn more with each impact. The data from new measuring technologies can be permanently evaluated and collected for quality assurance, optimizations and production increases. In a second step, the data can be

used as basic data for new products or be utilized for initial programming of a new press. In this way, new plants can act directly as “smart participants” in the cluster of the production process.

The development

iForge is the result of numerous developments and research projects of SMS group as Leading Partner in the World of Metals. For this purpose, let's take a look back into the past and list reasons leading to this development.

Closed-die forging presses for mass production classically consist of press column, drive and a so-called ram onto which also the top die is attached. These basic and relatively simple machines have been further developed. Nowadays, the modern closed-die forging presses of SMS group are equipped with a high-performance and cutting-edge control system enabling the entire process to be monitored. This also includes the cleaning and cooling process taking place between forging operations.

The challenge

We currently have an easily controllable forging press. It is however problematic that only by tool change, examination or measurement of the parts already forged it can be ascertained whether the tools have to be replaced. In practice, ►

the tools used in mass production are replaced at certain intervals without having reached a state of wear which would necessitate a replacement. Tools which would be able to still produce a high number of units are often replaced or a replacement is realized too late causing scrap parts to be produced. But how can this be changed?

The solution

The future lies in the digitalization of processes. In this case, the key components are not significantly modified since the physics and the basic process are not modified in principle. However, the framework conditions will change.

At present, the person in front of the operating panel is the start and control point of the process deciding whether the machine is to run faster or whether the spraying cycles for cooling and lubricating the dies may be longer or shorter. In case of maloperation security mechanisms will indeed be activated, but it is always possible to override them.

The answer can only be: the right decision must be made by the machine alone.

Sensor system and data collection

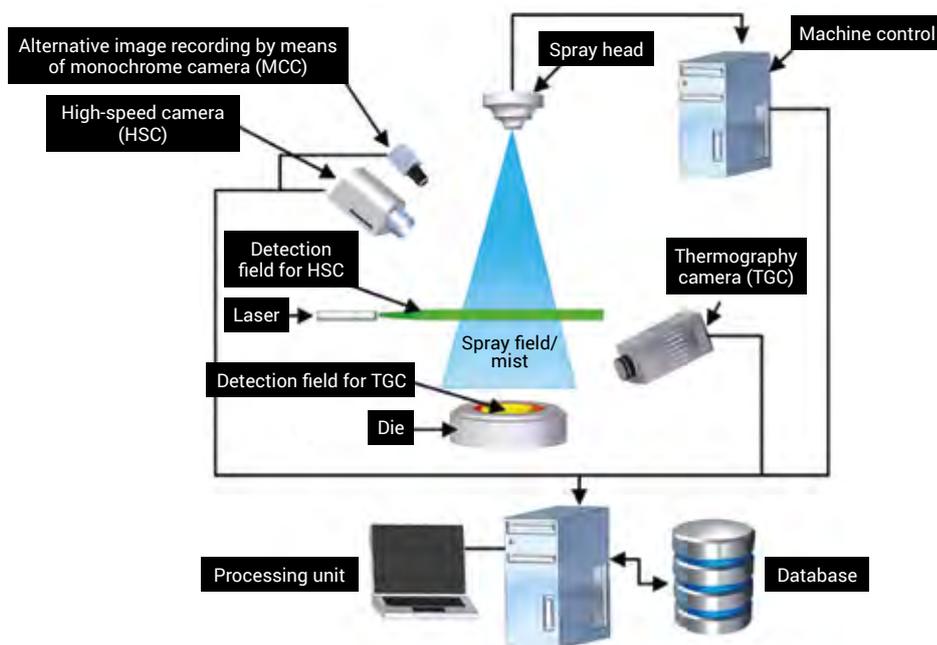
The plant can only make meaningful decisions when it is provided with an adequate sensor system, communicating with it in real time and when it learns from the data and the results. Nowadays, data communication is the focus of modern processes and future-oriented technology. Basically, this process could be realized today already via data lines with

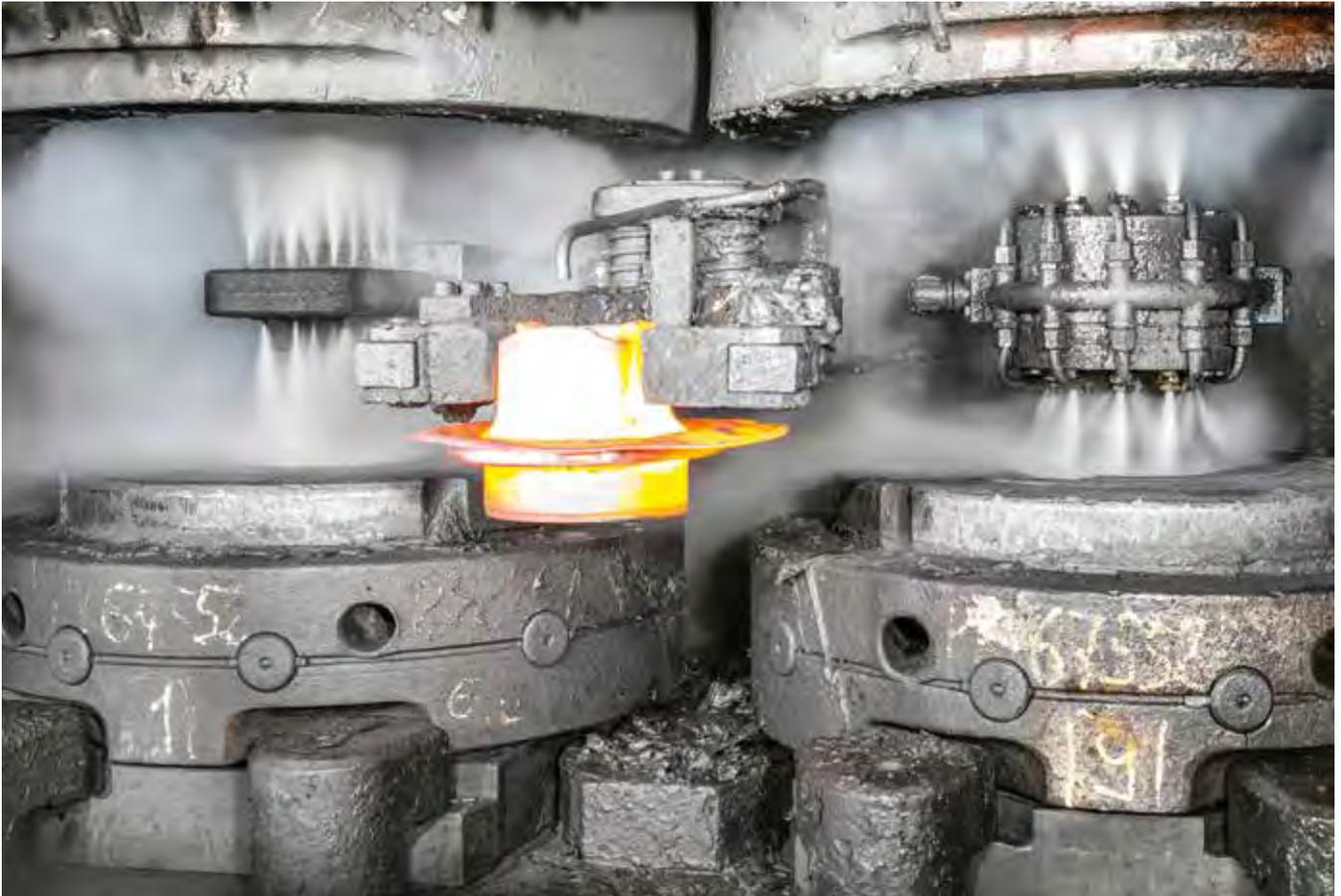
transmitting and receiving equipment within the machine. At present, however, “sensory organs” are missing to create a smart machine from a machine complex. The closed-die forging press of the future will therefore be equipped with sensor technology as sensitive as possible. Here, the surface of the dies can be taken up under different criteria. Key data are inter alia the temperature distribution over the mostly complex surface. This information provides the relevant data source to localize the points in the die most severely exposed to thermal stress. Often, it can also be concluded that these points are worn. Another key indicator providing insight into the quality of the parts is the tilt of the die halves to one another. If the parallelism to each other is no longer ensured the parts will be differently high; i.e. they are rejects as soon as the tolerances are exceeded.

Automatic detection and novel components

Nowadays, high-resolution cameras with the corresponding software are able to provide accurate readings and monitor the quality. To detect such and additional data SMS group develops sensors supplying the relevant data to the press.

During ongoing operation e.g. the spray system is able to react accordingly to the signals. A new development of SMS group shows what enormous potential for optimization exists for plant operators. SMS group has engineered innovative and significantly lighter-weight spray heads which are manufactured with flow-optimized channels through 3D printing or additive manufacturing. The main benefit is that





View into the press area of a closed-die forging press. An additively manufactured spray head (left) and a conventionally manufactured spray head (right) in use.

the spray heads are able to activate individual nozzles and thus cool the dies systematically and exactly according to the thermal load within no time.

Future opportunities

The main concept of this smart closed-die forging plant is based on a university project of the Institute for Forming Technology and Metalforming Machines (IFUM) from 2015.

In this perspective, SMS group has developed a sensor system, digital intelligence with iForge and innovative components such as 3D spray heads. It should however be noted that the right path up to complete digitalization of forging processes is taken but there is still a large distance ahead of us. We can already see what enormous opportunities it offers. Continuous monitoring while simultaneously reacting in real time has already been implemented for many machines, vehicles and systems. Through the activities of SMS group this future is a realistic target even for closed-die forging plants. ◆

BENEFITS

- Less rejects
- Optimal utilization of tool service lifes
- Predictable tool change
custom-designed for the product
- No maloperation by humans
- Higher productivity and quality
- Robust and reproducible processes

“For the experts from our manufacturing center precision is no problem. A mutual technical exchange with other industrial branches is free of charge on top of it.”

*Joachim Gietmann, Head of SMS group
Manufacturing Center in Mönchengladbach*



GERMANY

PRECISION FOR WORLD MARKET

Contract manufacturing in Mönchengladbach manufacturing center successfully expanded.

The concept of SMS group for the manufacturing location in Mönchengladbach is based on four pillars. "We manufacture for our Long Products, Forging Technology and Technical Service Divisions plus for external customers under the term contract manufacturing," explains Joachim Gietmann, Head of the Manufacturing Center in Mönchengladbach. The expansion of the business field contract manufacturing has been intensely pursued by SMS group since mid-2018 with a focus on high-precision, very sophisticated components including customers' know-how. With this concept, SMS group has actively approached the plant manufacturers in the German-speaking region – with positive feedback. There is a particular demand for precision manufacturing. Here, the SMS group manufacturing center in Mönchengladbach supported e.g. for reasons of capacity Liebherr Components GmbH in Biberach as partner for machining one of the biggest antifriction bearings built by Liebherr. The bearings are employed among others in ship cranes for offshore industries featuring a diameter of 17 meters and more. Manufacturing large antifriction bearings in this field of application is a challenging task not only as regards their dimensions. A segmentation of the components certainly facilitates the transport to the construction site significantly and simplifies also the handling. However, this segmentation also increases the requirements for precision. "This is no problem for the experts from our manufacturing center, and a mutual technical exchange with other industrial branches is free of charge on top of it," Mr. Gietmann makes clear. ♦

EXPERTS IN CLOSE COOPERATION

Top-quality plant solutions are created in the SMS group manufacturing center in Mönchengladbach in close cooperation with customers and partners. There is a high demand in particular for precision manufacturing.

 **Joachim Gietmann**
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INTERVIEW

COMPREHENSIVE SERVICES

Reducing downtimes, increasing productivity and maintaining the value of the plants: Jochen Burg and Johannes Kahlen are convinced that the Technical Service of SMS group ensures long-term success.

Mr. Burg, how important are service products nowadays for plant operators?

Jochen Burg: Very important because each production stoppage or plant downtime costs the plant operator a lot of money. Availability, quality and predictability are therefore basic requirements for stable and profitable production. The services offered by us enable plant operators to sustainably extend their own production capabilities.

Which service products are offered by SMS group and which developments are identifiable?

Jochen Burg: Basically, the service business is continually developing. The classical service products in the fields of spare parts & logistics, upgrades and modernizations, inspections & repairs or training & consulting will be revolutionized by the influence of digitalization. For that reason, we closely cooperate with the newly established Digitalization Division because we also want to use the insights and opportunities of the learning steel plant in our services for our customers.

Mr. Kahlen, last year many service projects have again been successfully implemented

by SMS group. Which of them do you remember in particular?

Johannes Kahlen: There are many projects I now remember. But of course, I immediately remember the large outsourcing projects, such as those of our Russian customers MMK and NLMK or Big River Steel in the U.S. where our service experts master the maintenance tasks in steel plants, rolling mills and strip processing lines day after day and hand in hand with our customers. But I should also like to emphasize our local repair and modernization assignments at our customers or in our company. And we are able to react flexibly in our own workshop, in particular when unplanned machine downtimes occur. With this possibility, we were able to offer successful services to our customers thyssenkrupp, SSAB and Deutsche Giessdraht GmbH in the past year. And we must not forget the on-schedule and successful handling of many thousands of spare parts orders. This service feature will continue to be our core business in future.

These services can only be accomplished with qualified service experts. How is the Technical Service of SMS group positioned?

Jochen Burg: Worldwide, we employ more than





Responsible for the Technical Service of SMS group: Johannes Kahlen and Jochen Burg (on the right).

3,000 people, about 500 of them in Germany and we operate at 52 locations, i.e. often directly at customer's plant. This shows that our Technical Service has a global presence and is positioned close to its customers. Our employees are characterized by a combination of technical knowledge, maintenance routines and operator's know-how.

With its worldwide workshops SMS group is close to the customer. Which service products are also offered to customers to ensure that quick support is provided despite great distances?

Johannes Kahlen: In our workshops in Brazil,

China, Europe, India, Russia or in the U.S. we are able to overhaul all core products of SMS group. Particularly, our maintenance services are increasingly utilized by the customer. We operate spare parts warehouses through to taking over complete servicing. Almost classical are our remote electrical and automation support services. A new product is remote support including Augmented Reality (AR), with the aid of which our service experts are given an idea of the problem and are able to help in a remote way.

Are there products which sell particularly well or are in high demand? And if so, why?

Johannes Kahlen: At present, everybody ▶



talks about digitalization and new business models. Yes, it's hard to believe, but the classical spare part in proven SMS group quality still continues to play a major role in our service business. This pillar will also be further expanded by us in future.

Jochen Burg: For our customers the focus on core processes and the associated outsourcing of maintenance services plays an ever-increasing role. Unfortunately, more and more customer's expert knowledge goes into retirement. In contrast, there is an increasingly complex plant technology to meet the requirements of the global markets. Our customized outsourcing projects and our many years of experience in this field provide planning security along with cost efficiency.

As Leading Partner in the World of Metals SMS group offers its customers technical services not only after commissioning of the plants but far ahead. How can we imagine this?

Johannes Kahlen: Already during the construction of the plant we are involved in the planning process and in the equipment, e.g. of initial spares or warehouse solutions. In addition, the plant personnel can be trained at an early stage by means of our training concepts. To accomplish this, SMS TECademy provides a wide array of training sessions which can also be used as refreshment courses. So, for example, we have opened our digital classroom at the beginning of 2019 where maintenance operations can be trained on the plant in a virtual environment. And this, before the real plant has been set up which is an enormous advan-

“Our service products offer the plant operator security he needs in order to focus fully on production.”

Johannes Kahlen, Division Head, Technical Service, SMS group

tage for a quick and successful start of plant operation. Of course we also offer our customers the option to take over maintenance work directly with commissioning. With the outsourcing of maintenance services – our TOS (Technical Outsourcing) – we take the burden off the shoulders of the plant operator so that he must only focus on his priorities, i.e. the production process.

As soon as the customer's plant has started production SMS group as Leading Partner is available with services. Isn't it a comforting feeling for the customer?

Jochen Burg: I would hope so. That is at least what the customers told me. The Technical Service can be contacted around the clock which is indeed a reassuring feel. Our services are offered for both new installations and upgrades and also for plants which have not been set up by SMS group.



The Technical Service is available around the clock – even for plants which have not been built by SMS group.”

Jochen Burg, Division Head, Technical Service, SMS group

In what way does SMS group's Technical Service stand out from its competitors?

Johannes Kahlen: SMS group is the only plant manufacturer in the metallurgical sector covering the entire process chain. Consequently, we are the only service provider worldwide able to meet the complete maintenance demand of our customers. In addition to that, our reference status speaks for itself. With more than 30 outsourcing projects worldwide and the associated off- and online maintenance of whole plant parts we prove day after day that we fulfill the confidence of our customers time and again.

How has our Technical Service positioned itself in the age of Industrie 4.0?

Jochen Burg: For our Technical Service and its products digitalization plays an important role. Already many years ago, we have created the first digital products. These may include, for example, our smart maintenance solution prod-

ucts: electronic documentation (eDoc), integrated maintenance management systems (IMMS), condition monitoring systems (Genius CM®) or predictive maintenance approaches. We want to continually further link these and other products providing already today the gateway into the digital age. Furthermore, augmented and virtual reality applications are employed. The opening of the digital classroom is a current example. Finally, I would like to mention our digital fact-finding offering each customer an inventory of “digital readiness” and showing him possible paths of action.

Where do you see further business growth for the Technical Service?

Jochen Burg: We are looking into an exciting future. On the one hand, digitalization opens up new business models and paths and on the other hand there are still many white dots worldwide in our product portfolio. Above all, I do see the further expansion and complement of our services in all core regions to make sure that we continue to be close to our customers.

Johannes Kahlen: But also the quick and cost-efficient supply of spare parts is further optimized. For that reason, we are working intensely on additive manufacturing technologies. The first spare parts are already printed. ♦



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INTERVIEW

FIT THANKS TO SELECTIVE TRAINING

Karsten Weiß, Head of TECademy, on the current training courses at customer's training academy and the new digital classroom.

Mr. Weiß, how important are training courses for plant operators at the present time?

Highly important. We are able to train the plant personnel on our training concepts at an early stage. Our SMS TECademy provides a wide array of training courses, also as refresher training. So, for example, we opened our digital classroom at the end of last year. Here, virtual maintenance operations can be practiced before the real plant has been set up which is an enormous advantage for rapidly starting plant operation.



What are the unique features of the SMS TECademy?

SMS TECademy is an internationally active customer's training academy. Apart from organizing training courses for new plants, the academy also offers a number of specialized training courses on selected topics such as technology, servicing and plant engineering and eLearning on certain dates. Customized training specially designed to the needs and wants of our customers complements the range of services.

What are the advantages of employing Virtual and Augmented Reality?

These technologies make a 3D view or a virtual insight into machines, plants or even entire halls possible. The learner





is “standing” in the center of the plant and is able to “penetrate” further into it to be able to view all assembled parts; and he/she can remove and rotate them virtually, and view them in detail.

Have you been able to gain experiences with these technologies?

Certainly. We have produced a complete training scenario taking, as an example, a hydraulic training course. The image portrayed on augmented or virtual reality glasses is also transmitted on a large-screen monitor to make sure that other training participants can also witness the process live. At the same time, smart information superimposed with the real exhibited hydraulic pump can be brought within the viewer's field of vision via AR glasses. This allows you to create several scenarios such as dismantling and assembling the pump in single steps. The configuration is comprehensible, assembly and dismantling operations can be repeated any number of times – until the learner knows his or her way around perfectly. In the VR application it is even possible to work “hand in hand” with a colleague to unfasten screwed connections or position hoses or flanges.

Will the training material be displayed also digitally?

Yes, we therefore use tablets. The training documents are available in an electronic format via the mySMS group account. The participants have their personalized access to view the training material. During the training courses they are able to create notes which are also stored in the account. Access to these documents is possible at all times, even beyond the end of training.

How do you draw attention to the training courses?

After the opening of the digital classroom we have meanwhile started to offer practical training in Mönchengladbach. Apart from our offer on the website, there is also a conventional training brochure available. We are also very glad that our offer is also conveyed to our customers around the world by our colleagues. In addition to that, we are pleased to introduce our new concepts and contents at the METEC 2019 in Düsseldorf. ♦



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Further information

www.sms-group.com/expertise/sms-tecademy/overview

SOUTH KOREA

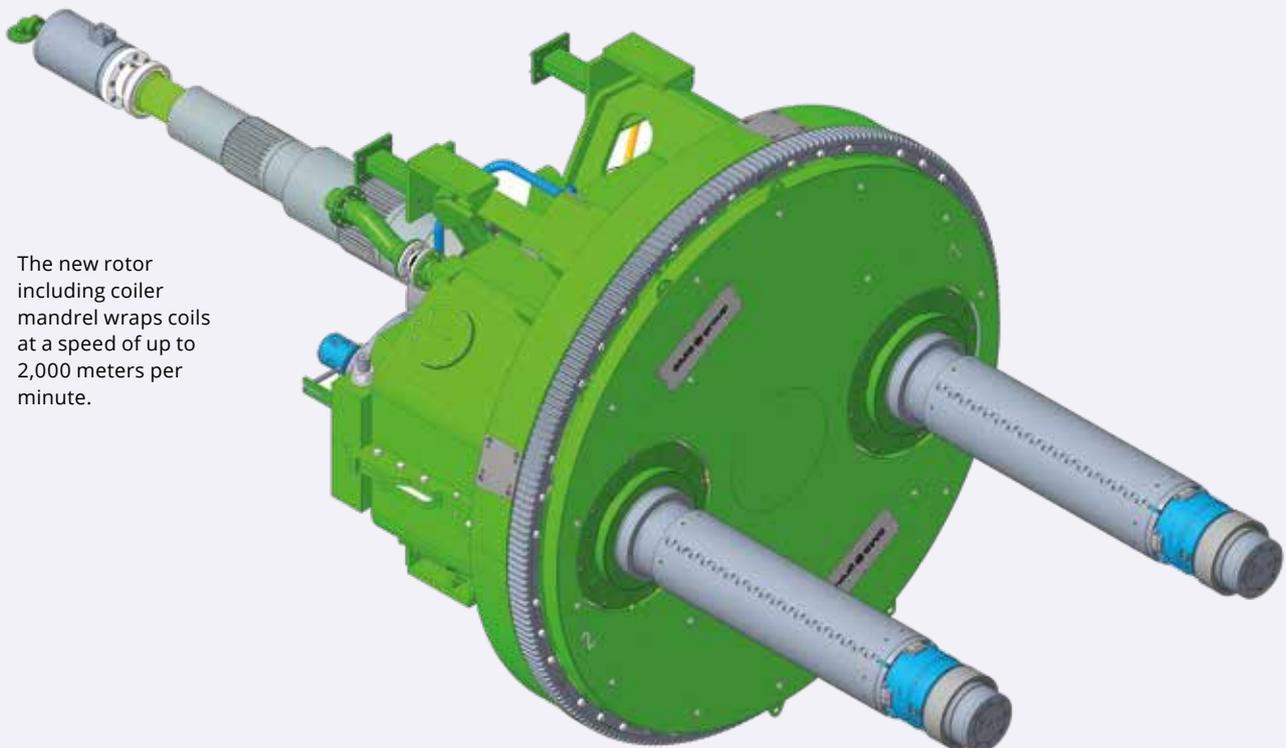
NEW ROTOR FOR DONGBU STEEL

Dongbu Steel has placed an order with SMS group's Technical Service for the delivery and installation of a new rotor with coiler mandrels for its tandem cold mill. Back in 1999, SMS group supplied the main production facilities for Dongbu's Asan Bay plant. Specifically, these included: a continuous pickling line/tandem cold mill with five mill stands of six-high design, one continuous hot-dip galvanizing line, and one two-stand DCR cold rolling mill (DCR = Double Cold Reduction).

The carousel reel installed in the exit section of the tandem cold mill ensures that the finished strip is continuously coiled.

The use of two mandrels means that the next-in-line coil can be wrapped while the other coil is being taken away. The newly designed coiler mandrels offer greater stability and, thanks to the optimized lubrication system, can be serviced far more easily. With the new rotor and coiler mandrels for the carousel reel, SMS group is able to guarantee that coils can be wrapped at a speed of 2,000 meters per minute in future, too.

 **Stephan Schallenberg**
stephan.schallenberg@sms-group.com



The new rotor including coiler mandrel wraps coils at a speed of up to 2,000 meters per minute.

During their visit of SMS group's test center in Mönchengladbach all participants became familiar with the newest innovations of SMS group.



GERMANY

INTERNATIONAL VISIT

A delegation from the Association for Iron & Steel Technology (AIST) visited the test center for electrical equipment and automation systems in Mönchengladbach at the end of 2018.

On December 7, 2018, a delegation from AIST consisting of colleagues from Mexico, Brazil and the U.S. visited the SMS group test center in Mönchengladbach. During the visit, "Digitalization at SMS group" was the core topic. Wolfgang Linden from SMS group presented the digital solutions from the X-Pact® electrical and automation product range as well as new, innovative concepts for implementing the "learning steel mill". Attention furthermore focused on the intelligent production planning system X-Pact® MES 4.0, which increasingly utilizes methods based on artificial intelligence, as well as the Process Data Warehouse solution from SMS group, the new digital classroom using AR and VR technologies for customer training, and the smart applications for the metals industry already provided via the mySMS group platform.

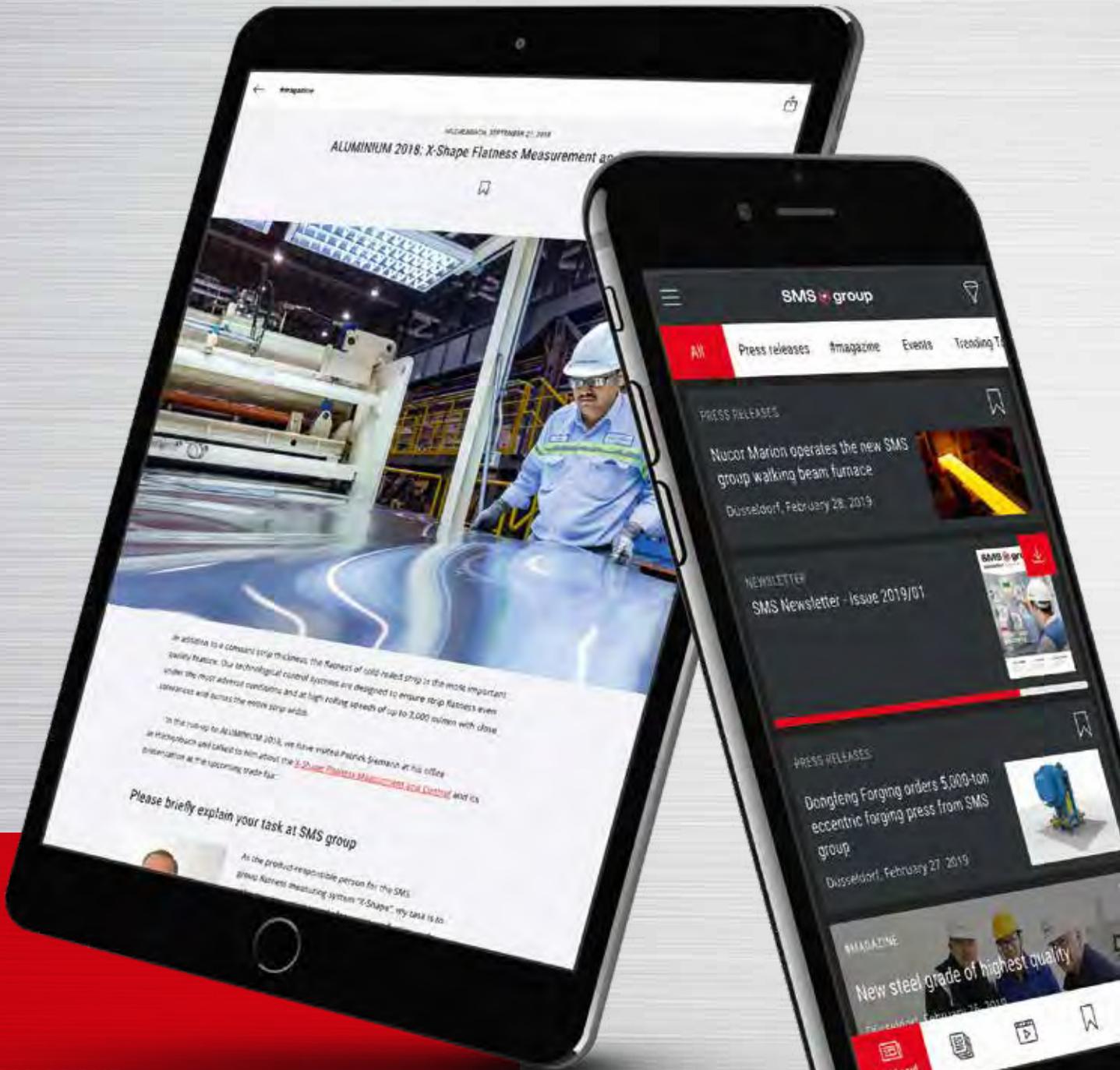
A live presentation of the automation system for an electric steelmaking plant consisting of EAF, LF and VD units implemented in the framework of the Plug & Work integration test provided an impressive demonstration of process-focused operation using X-Pact® Process Guidance.

Experts from the field of metallurgy informed the interested visitors on the latest X-Melt® performance modules for electric steelmaking, such as the CONDOOR® and SIS burners. The latest developments for the productivity-boosting process units Primary Energy Melter (PEM) and Sharc as well as gas cleaning systems for the U.S. market completed the impression of the modern technologies from SMS group.

The visit was concluded by a presentation from Marcus Hüllen providing a deep insight into the field of additive manufacturing and powder metallurgy – the latest future-oriented technologies from SMS group.

The event was met with great interest by the AIST delegation. All visitors thanked SMS group for the informative day. ♦

 **Wolfgang Linden**
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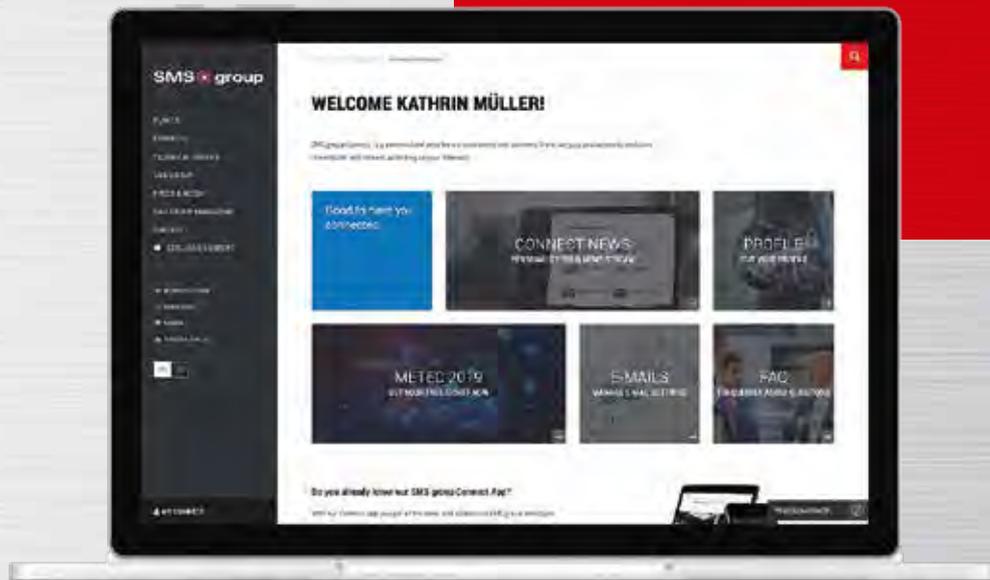
SMS GROUP CONNECT APP

News and topical information at a glance, complemented by access to exclusive content – at any time, on your mobile and offline. With customized content and push notifications, the new “SMS group Connect” App keeps you updated on relevant content. “SMS group Connect”, which replaces our App “SMS group Magazine”, also allows you to read our customer magazine, the SMS group Newsletter. The new App is available for Android and iOS.



SMS GROUP CONNECT ACCOUNT

The new "SMS group Connect" feature keeps you up to date on information about SMS group - latest news, background information, etc. You can view all this at a glance on your monitor and even create your customized dashboard to make sure that you do not miss out on any information of special interest to you. Certain content may be available exclusively to registered users. You may use our email service to be kept informed about our offers, products and events. In this way, you stay in the know of what is happening in our industry.



WORLDWIDE

KEEP IN TOUCH

Feature stories, relevant information and services – customized and exclusive. This is what you get from SMS group's latest digital offers. Experience the world of SMS group with the new "SMS group Connect" log-in and the new "SMS group Connect" App for your mobile devices.

PREVIEW



IN OUR NEXT NEWSLETTER ISSUE ...

... you will learn more about the international orientation of SMS group. As Leading Partner in the World of Metals the company has locations all over the world and very close to its customers to be able to quickly respond to their wishes and requirements.

To be close to the customer also means playing a visible and active role in the local markets. Therefore, the employees of the numerous SMS group subsidiaries around the globe are available for support with their know-how at any time and wherever needed: experts knowing the trade and speaking the local language. What's more, the global network of regional offices, service facilities and workshops provides the basis for a successful production process.



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The information provided in this magazine contains a general description of the performance characteristics of the products concerned. The actual products may not always have the characteristics described and, in particular, these may change as a result of further developments of the products. The provision of this information is not intended to have, and will not have, legal effect. An obligation to deliver products having particular characteristics shall only exist if expressly agreed in the terms of the contract.

DIGITALIZATION

In times of rapidly changing markets, you want to optimize your plants to stay ahead. We listen. We learn. We deliver: our automation and digitalization specialists will help you implement learning mills that will boost efficiency, lower operating costs, and increase productivity. Whatever you envision, we will make it happen for you.

Leading partner in the world of metals

