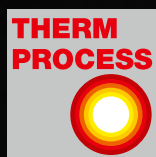
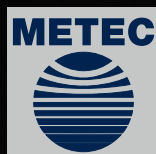


STEEL+ TECHNOLOGY

THE TECHNICAL MAGAZINE FOR IRON AND STEEL PROFESSIONALS AROUND THE WORLD



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METEC – ESTAD 2019

Metallurgical trade fair and steel congress will highlight digitalisation and green steel

STEEL TECHNOLOGY

ArcelorMittal investigates the industrial use of pure hydrogen for direct reduction

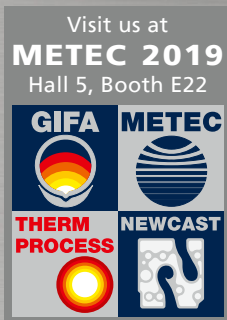
STEEL DISTRIBUTION

SSAB enhances steel services for customers in Central and Eastern Europe

STEEL PROCESSING

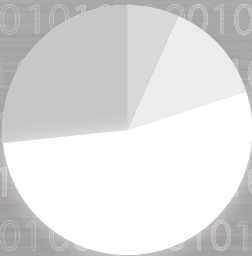
Digital networking of production and logistics processes in metalworking

DIGITALIZATION



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Digitalization and climate change are transforming the metallurgical value chain

These days the leading experts of the international steel industry will be travelling to Germany to meet at METEC 2019 - the premier international trade fair for metallurgy and steel production hosted in Düsseldorf every four years. Machinery, plants and products for the steel industry, environmental and resource preservation or energy efficiency - if you want to be actively involved in shaping the industry markets, then METEC 2019 is the place to be.

Its concept is unique. METEC runs in parallel with three other trade shows: the foundry fair GIFA, the trade fair for thermo process technology THERMPROCESS and the trade fair for castings NEWCAST. This international trade fair quartet is a one-of-a-kind platform for meetings and business. Last but not least, the four exhibitions are accompanied by top-class conferences, symposia and technical forums. The 4th European Steel Technology and Application Days (ESTAD) is once again the accompanying steel conference of the METEC trade fair. At this event attendees can acquire latest information on new ideas and developments as well as on the state of the art in metallurgical process technologies for iron and steel production, steel materials and steel application. METEC trade fair and the 4th ESTAD congress will provide answers to many of the challenges steel companies are presented with these days.

The steel industry finds itself in the situation to deal with three key issues: climate change and the political pressure to drastically reduce CO₂ emissions; full digitalization of the steel sector; newly developed steel grades particularly for application in 3D printing and electric powered vehicles.

If you are not going to visit METEC, you will see all these megatrends also covered in STEEL + TECHNOLOGY, the proficient media platform for exchanging information about how the steel industry is adapting to a changing environment. For instance, we had the opportunity to take a backstage look at a digital company of very special set-up. SMS digital GmbH develops innovative products and services which it uses to "digitalize" the metals industry. The young company is a subsidiary of SMS group, which has made digital transformation a central pillar of its business strategy. Enjoy reading the interview and all the other stories in this issue, most of them dealing with the above mentioned megatrends.



Arnt Hannewald, Dipl.Ing.
Editor

Arnt Hannewald

DANIELI

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TURNKEY PLANTS
SUPPLIED
WORLDWIDE



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DIRECT REDUCTION
PLANTS



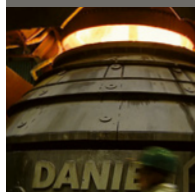
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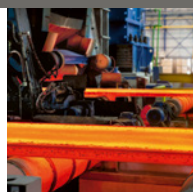
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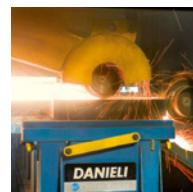
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CASTING STRANDS
FOR SLABS, BLOOMS,
AND BILLETS



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SLAB, BLOOM,
AND BILLET
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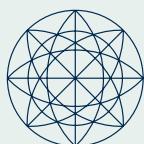
PROCESS CONTROL
SYSTEMS

Danieli Automation automates plants through integrated systems for equipment, process and power control, handling jobs from order placement through product delivery. Event-prediction and problem-solving operator assistance are ensured by the innovative 3Q system.

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HOT STRIP, PLATE
AND COLD MILLS



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HEAVY SECTION,
RAIL, BAR AND
WIREROD MILLS



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SEAMLESS AND
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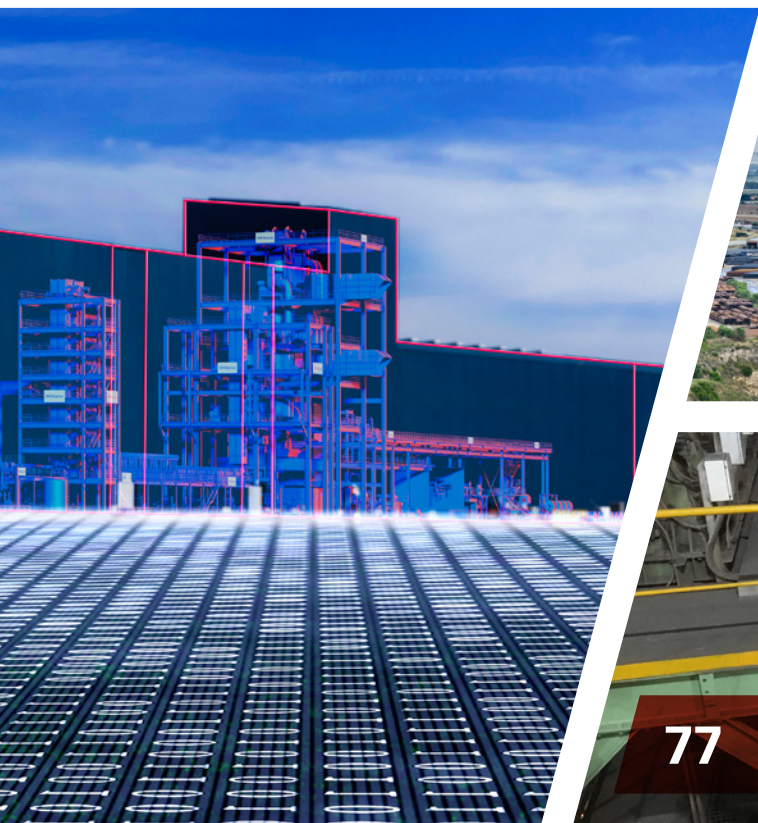
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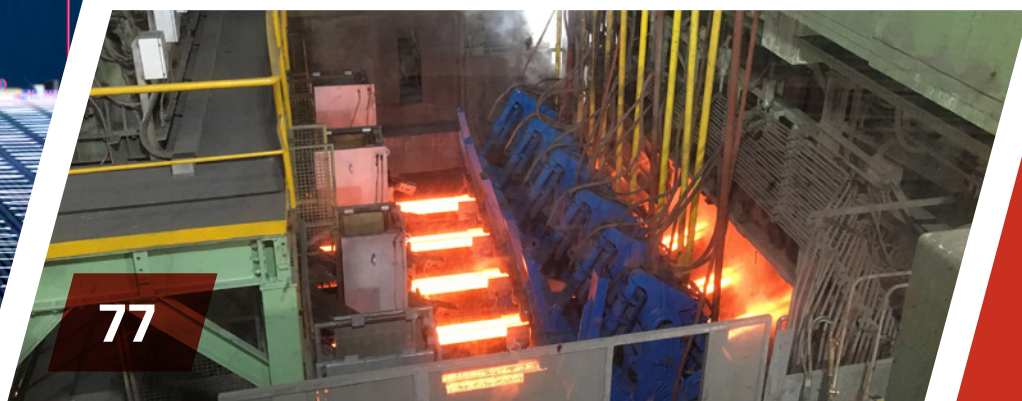
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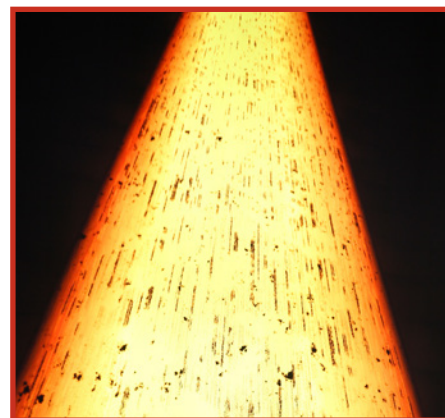
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Cover picture: ©Messe Düsseldorf/ctillmann

The Bright World of Metals
25 - 29 June 2019, Düsseldorf, Germany

I Messe Düsseldorf GmbH
www.tbwom.de

US-American researcher receives research scholarship by Alexander von Humboldt Foundation

This scholarship allows Dr. Michael Ashton, who joined the Max-Planck-Institut für Eisenforschung (MPIE) as postdoctoral researcher in 2018 to continue his work at any German research institution of his choice for up to two years.

"I was eager to continue my research in Europe after my Ph.D. to experience a different research landscape and benefit from the intercultural exchange. My first contact with the Max-Planck-Institut für Eisenforschung was through the publications of Prof. Neugebauer and his team. So, I decided to move to Germany and chose the MPIE for my stay", explains Ashton. Ashton currently

works in the department of Computational Materials Design headed by Prof. Neugebauer.

The material scientist obtained his Ph.D. at the University of Florida, USA, where he developed computational methods for the discovery and characterization of two-dimensional materials. He is now working to extend these concepts and methods to surfaces in extreme electric fields. Ashton works closely with MPIE's experimental groups to study how surfaces behave, and ultimately evaporate, under extreme electric fields. Ashton's studies aim at understanding the atomistic details of the evaporation process and then using this

knowledge to provide better control over interesting electric-field triggered processes.

Scientists from over 35 nations are working at the MPIE to develop materials applicable in the fields of mobility, energy, infrastructure, medicine and safety. Some of these scientists are funded by the Alexander von Humboldt Foundation that supports excellent researchers from outside Germany with scholarships to continue their work in a German research institution of their choice.

I *Max-Planck-Institut für Eisenforschung (MPIE)*

Algoma Steel appoints chief executive officer

Michael McQuade, currently a director of Algoma, is going to be the new chief executive officer of Algoma Steel.

Michael McQuade has more than 35 years of steel industry experience in a number of senior leadership positions. Prior to

becoming a director of Algoma in 2018, he held a variety of roles in finance, accounting, operations, and sales at Stelco and became Stelco's president in 2014.

Michael McQuade succeeds Kalyan Ghosh, who served as chief executive officer prior to and during the success-

ful restructuring of Algoma's business in 2018 and has resigned from the company to pursue other opportunities.

I *Algoma Steel*

NLMK Group fills newly created position of vice president digital transformation and IT

Consolidating its digital transformation and IT practices, NLMK Group has appointed Dmitry Kholkin to the newly created position.

Dmitry Kholkin previously served as vice president for digital transformation.

The new function has been formed by merging digital transformation and IT practices. According to Grigory Fedorishin, NLMK Group president, consolidation of digitalization and IT under a single leader will link digital tools with the company's strategic

goals and speed up the automation efforts aimed at streamlining processes.

I *NLMK Group*

Executive changes at Nucor

Chief digital officer and executive vice president, R. Joseph Stratman, has retired after more than 29 years of service with Nucor.

R. Joseph Stratman began his career with Nucor in 1989 as controller of Nucor Build-

ing Systems-Indiana. He served as executive vice president of business development, executive vice president of raw materials and most recently as chief digital officer and executive vice president.

Effective May 19, 2019, MaryEmily Slate was promoted to executive vice pres-

ident and will assume responsibilities for the tubular products group, logistics and certain joint ventures.

I *Nucor*

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U.S. Steel names senior vice president of strategic planning and corporate development

Richard L. Fruehauf has been appointed as senior vice president of strategic planning and corporate development of United States Steel Corporation.

Richard L. Fruehauf will continue to oversee the departments of strategic planning and business development, innovation, governmental affairs, environmental affairs and sustainability and corporate communications in

his expanded role. He will continue to report to president and CEO David B. Burritt.

| United States Steel Corporation

Changes to board of directors of Schmolz + Bickenbach

At the annual general meeting on April 30, 2019, all nominations proposed by the board of directors of Schmolz + Bickenbach AG have been approved. Chairman Edwin Eichler left the board.

The new chairman of the board of directors is Jens Alder. Newly elected to the board were Alexey Moskov and Adrian Widmer. Michael Büchter, Martin Haefner, Isabel Corinna Knauf and Dr Oliver

Thum were re-elected as board members.

| Schmolz + Bickenbach

Key positions at Montan-Stiftung-Saar and Dillinger filled after sudden death of previous incumbent



Reinhard Störmer succeeds Dr. Michael Müller as chairman of Montan-Stiftung-Saar (Picture: SHS)



Martin Baues is the new chief technical officer of Dillinger and member of the SHS executive management (Picture: SHS)

Reinhard Störmer succeeds late Dr. Michael H. Müller as chairman of the curatorship for Montan-Stiftung-Saar. Martin Baues takes over key positions at Dillinger and SHS.

Martin Baues has been appointed by the supervisory board of Dillinger as a member of the board of management of Dillinger as chief technical officer and by the supervisory board of SHS - Stahl-Holding-Saar as a member of its executive management. Martin Baues is now responsible for the technical divisions of both Dillinger and Saarstahl. "With the decisions that have now been taken, Montan-Stiftung-Saar is resolutely continuing on the course set by the previous chairman, Dr. Michael Müller. Our actions are focused on further merging the Dillinger and Saarstahl steel companies as well as on investments in promising business fields and process optimization," Reinhard Störmer commented on the appointment of Martin Baues.

| SHS – Stahl-Holding-Saar

New member of the supervisory board of thyssenkrupp

Prof. Dr. Siegfried Russwurm has recently been appointed to the supervisory board of thyssenkrupp.

With the addition of Siegfried Russwurm, a former member of the manag-

ing board of Siemens and chairman of the shareholders' committee and supervisory board of Voith GmbH & Co. KGaA, the supervisory board of thyssenkrupp AG is complete again. Siegfried Russwurm is internationally regarded as one

of the pioneers of digitalization in the industry.

| thyssenkrupp AG

Marocco

Riva Industries to build new meltshop and continuous caster

To be installed in the industrial area of Medz an Jorf Lasfar beside an existing rolling mill, the new facility to be supplied by Danieli will produce 800,000 t/year of 130 mm to 200 mm billets.

The new meltshop will include a 100 t Fastarc™ EAF with technological pack-

ages such as the EAF Q-Melt suite, Lindarc off-gas laser system, electrode regulation system, automatic EBT sand refilling and the Danieli automatic EAF de-slagging door. The four-strand, 9-m-radius FastCast™ machine will produce a great variety of low- and medium-carbon grades at high produc-

tivity rates. Danieli Automation will supply the level 2 process control system. Plant start-up is scheduled for mid 2020.

| Danieli

USA

AZZ completes purchase of Tennessee Galvanizing

Following the purchase by AZZ, Tennessee Galvanizing will from now on operate as AZZ Galvanizing – Chattanooga.

AZZ Inc., provider of metal coating services, welding solutions, specialty

electrical equipment and highly engineered services, has completed the purchase of Tennessee Galvanizing Inc., a privately held company, based in Jasper, Tennessee. It operates four galvanizing lines, including centrifuge,

rod, conveyor, and traditional hot-dip galvanizing.

| AZZ Inc.

USA

Big River Steel to expand steel plant

Big River Steel (BRS) has commissioned SMS group with the expansion of its steel plant in Osceola, Arkansas. SMS group will supply the mechanical equipment, electrical and automation systems, and digitalization.

Since commissioning of the new mill in 2017, Big River Steel has been producing high-quality steels, including tube grade sheet for pipeline construction, silicon steels for a wide variety of energy and electric motor applications, and advanced high-strength steels for the North-American automotive industry. The expansion will increase the plant's annual output to about 3 million t of steel. 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 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 mm wide coils. The hot 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 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.

As Big River Steel pursues its strong focus on digitalization, also in the second construction stage, the PQA® (Product Quality Analyzer) system will be a central module of the process automation system. PQA® monitors, documents and assures the product quality down to the finished cold strip along the complete production process. The system takes "ship" or "block" decisions for the downstream processing of the strip or its dispatch. In the long run, the system provides higher yield while increasing the product quality.

| SMS group

Big River Steel expands its steel mill in Osceola, Arkansas (Picture: SMS group)



USA

Gerdau Midlothian starts up EAF process optimization system



Control room of an electric arc furnace (Picture: Danieli)

Gerdau has installed a Danieli Q-MELT system on its EAF "B" at its Midlothian plant in Texas.

Danieli's Q-MELT suite is an automatic system consisting of MeltModel, Q-REG and Lindarc technological packages and designed to improve EAF performance by lowering energy consumption, power-on time and electrode consumption. The Danieli Automation software for electric arc furnaces processes chemical and/or electrical profiles and makes the necessary process adjustments, dynamically and automatically, based on neural networking and with self-learning capabilities.

Gerdau Midlothian released the final acceptance certificate for the system after just 15 days of operation.

Danieli

USA

JSW Steel upgrades plate mill



As part of the first phase of the plate mill upgrade Danieli is replacing the primary descaler, hot plate leveller and plate shearing line No. 1 at JSW Steel's Baytown mill in Texas.

While the first phase of this upgrading project is underway, with commissioning of the new equipment expected to take place in autumn 2019, Danieli has meanwhile also been awarded the order for the second phase of the project. For that phase Danieli will replace the reversing rolling mill, install a pre-leveller, direct quenching and accelerated cooling, and replace the cooling beds and add a new cold plate leveller. The new 4-high mill stand will be equipped with PVR (plan view rolling) technology.

Danieli

Plate being rolled in a reversing mill
(Picture: Danieli)

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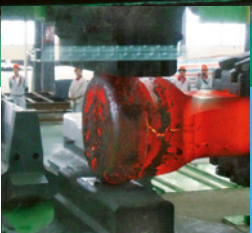


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Amir Tanbakouchi

Sales Manager North America, Russia, Middle East



USA

Nucor expands presence in regional rebar markets

Nucor has chosen technology from Danieli for its new rebar plants in Sedalia, Missouri, and Frostproof, Florida.

Danieli is supplying the complete technological equipment package for two MI.DA. rebar plants. The plants will produce in excess of 320,000 t/year (350,000 short tons per year) of straight and coiled rebar products in sizes,

grades and custom lengths to fulfill the most demanding construction applications. The mills will allow Nucor to exploit the abundant scrap supply.

At each new plant, a Danieli ECS® continuous scrap-charging preheating system will feed a 40 t, side-charged AC EAF and a ladle treatment furnace. The endless casting and rolling section will include a single-strand, high-

speed continuous casting machine directly connected to the 16-stand rolling mill for an uninterrupted production cycle. The mills will be put into operation in late 2019 and early 2020, respectively.

| Danieli

USA

Nucor to build new plate mill in Kentucky

A new plate mill in Brandenburg, Kentucky, will add 1.2 million t/year of steel plate products to Nucor Corporation's capacity.

The new plate mill will produce cut-to-length, coiled, heat-treated, and discrete

plate ranging from 1,520 to 4,060 mm wide, and in gauges from 4.8 to 355 mm. The selected location on the Ohio River will give Nucor logistical advantages in sourcing raw materials and serving customers throughout the Midwest. The mill is expected to be fully operational in

2022, pending permit and regulatory approvals.

| Nucor Corporation

USA

United States Steel resumes construction of electric arc furnace in Alabama

The company restarts the project that had been suspended in December 2015 due to unfavourable market conditions.

A technologically advanced EAF steelmaking facility will be built at its Tubular Oper-

ations in Fairfield, Alabama. The decision to complete the EAF, which includes modernization of the existing rounds caster, is expected to add about 150 full-time employees. The EAF will have an annual capacity of 1.6 million tons. Construction

is to begin immediately and the furnace is expected to be ready to produce steel rounds in the second half of 2020.

| United States Steel Corporation

USA

Zekelman Industries to build new continuous tube mill

The new 28" electric resistance tube welding line to be installed at its "Atlas Tube" structural tube division will be supplied by SMS group.

The new line will allow Zekelman Industries to produce structural and piling products with diameters ranging from 273 to 710 mm and wall thicknesses up to 25.4 mm. Furthermore square and rectangular hollows in dimensions 203 x 203 mm up to 559 x 559 mm or 34 x

863 x 254 mm will be produced. Products will meet or exceed ASTM A500, ASTM A1085, CSA G40 and ASTM A252. The more than 400,000 t capacity line will be the first ERW line in the USA to make sections above 150 mm (16") square.

Further to an operational speed reaching 35 m/min, the line will offer superior diameter/wall thickness ratio. It will also be engineered to allow for full change-over times of less than 60

min, as well as special forming and sizing technology for precise dimensional tolerance. While SMS group will supply the mill, Zekelman has selected Kusabe for the milling cut-off and Mair for the material handling and packaging line. Start-up of the new mill is scheduled for September 2021.

| SMS group

Colombia

SIDOC upgrades electric arc furnace

Colombian steelmaker SIDOC has installed a technology package from Danieli to reduce electrode consumption by its electric arc furnace in Acopi, Valle del Cauca.

Electrode consumption in EAFs is impacted among others by the lateral oxidation resulting from the exposure of the hot surface of an electrode to the ambient air. Electrode water-cooling is intended to produce a continuous water film that cools the electrodes, reducing the exposure and thus the oxidation rate.

The Q-Smartec supplied by Danieli independently controls the cooling water flow to achieve most efficient electrode cooling. Electrode consumption due to air oxidation is reduced by up to 15% compared to conventional electrode cooling systems.



I Danieli

Electrodes at the EAF during operation (Picture: Danieli)

Mexico

Prolamsa orders new slitting line

FIMI has signed a contract with Prolamsa for the supply of a slitting line.

The new line for Prolamsa - Productos laminados de Monterrey will be designed to process coils from 1.5 to 15 mm thickness and strengths of up to 1,200 MPa. The plant will be installed in the first half of 2020. Prolamsa is a leading manufacturer

of carbon steel tubes and components with plants and distribution centres in Mexico and the United States.

I FIMI

Mexico

Pacific Steel completes caster revamp

A continuous caster revamp by Danieli provides Pacific Steel an extended production range from commercial to speciality steel grades.

Exploiting the existing civil works, Danieli upgraded the caster in all its parts. The new moulds feature mould level control, in-mould and final stirrers, stopper rods to cast in open- and closed-stream mode and a flying nozzle-change device. The revamp

has improved overall performance and increased the production range at the facilities of Pacific Steel (SIMEC group) in Guadalajara.

I Danieli

Condition monitoring for continuous casting plants

- Cost reduction through predictive maintenance
- Caster strand optimization
- Customized solutions
- Tactile or laser based measurements
- Casting quality improvement

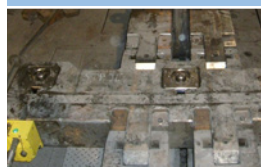


METEC 2019 - Hall 3, Booth E 01



Gaptor®

Offline condition monitoring system for slab and bloom casters



Gaptor®-IC

In-chain condition monitoring system for slab and bloom casters



MouldAlign

Condition monitoring of the transition from the mould to the first caster segment



Peru

Aceros Arequipa orders steel mill and continuous billet caster

SMS group is going to supply a 120 t AC electric arc furnace and a six-strand continuous billet caster to Aceros Arequipa.

The plant will be designed for an annual capacity of 1,200,000 t. In addition to the EAF, SMS group's scope of supply also includes a ladle furnace and a gas cleaning plant capable of processing over 2,200,000 m³/h of process gas.

SMS Concast will supply the six-strand continuous billet caster. It will

have a casting radius of 9 m and produce billets of 130, 160 and 180 mm square. The special inside geometry of the mould allows for better transfer of heat across the whole mould, with a uniform degree of solidification in the corners.

Significant reduction in operating costs will be achieved thanks to the direct connection to the rolling mills. SMS group will also supply basic and detail engineering, all mechanical and

electrical components, the entire 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. Start-up of the plants is scheduled for early 2020.

I SMS group

China

ChangBao orders seamless tube plant

A highly automated PQF® (Premium Quality Finishing) seamless tube plant supplied by SMS group will enable ChangBao to meet the growing demand for precise, high-strength tubes.

The PQF® will be used to produce tubes within a diameter range of up to 146 mm (6 5/8") and wall thicknesses of between 4 and 20 mm for oil and gas production (OCTG) and in accordance with API standards. The annual capacity will be 300,000 t. The order 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. The new seamless tube plant is scheduled to be commissioned in the first quarter of 2020.



The project teams of ChangBao and SMS group during contract signing (Picture: SMS group)

I SMS group

China

CRU forecasts Chinese coke capacity to fall in the coming decade

Since China has entered a development stage with slowing steel demand growth and with increasing scrap supply reducing the need for hot metal, the coke sector will continue to be subject to capacity consolidation and rationalization for environmental protection.

This is the result of a forecast released by privately owned business intelligence group CRU, which bases its report on the following main facts: The Chinese steel

value chain suffered great losses in late-2015 due to structural over-capacity. The government has since conducted a 'supply-side' reform by eliminating outdated and inefficient industrial capacity, including coke ovens. In addition to capacity reductions, the coke industry will also be 'greener' in the coming decade through the replacement of inefficient, small coke ovens by larger and cleaner ovens.

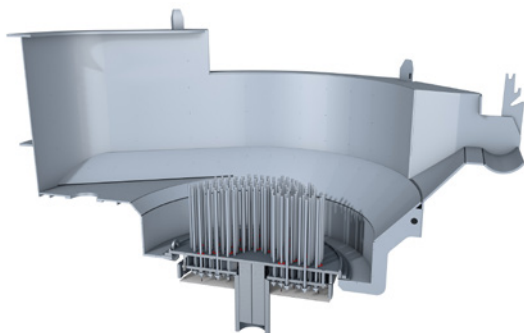
During the 13th National People's Congress (NPC) the Chinese government said

it would maintain the good results achieved in environmental protection over the last two years. This means that polluting industries, including coke operations, will be discouraged in coming years. Another aspect is that controlling coke capacity is much easier and less costly than restricting blast furnace operations and can achieve results acceptable to the government.

I CRU

China**Daye Special Steel to upgrade electric arc furnace in Xingyegang**

For this EAF upgrade, 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.



DC electric arc furnace with pin-type electrode (Picture: SMS group)

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. As part of the upgrade, Daye Steel's 75 t DC electric arc furnace will be scanned in 3D and the bottom part of the electric arc furnace vessel modified. Commissioning is scheduled to take place this year.

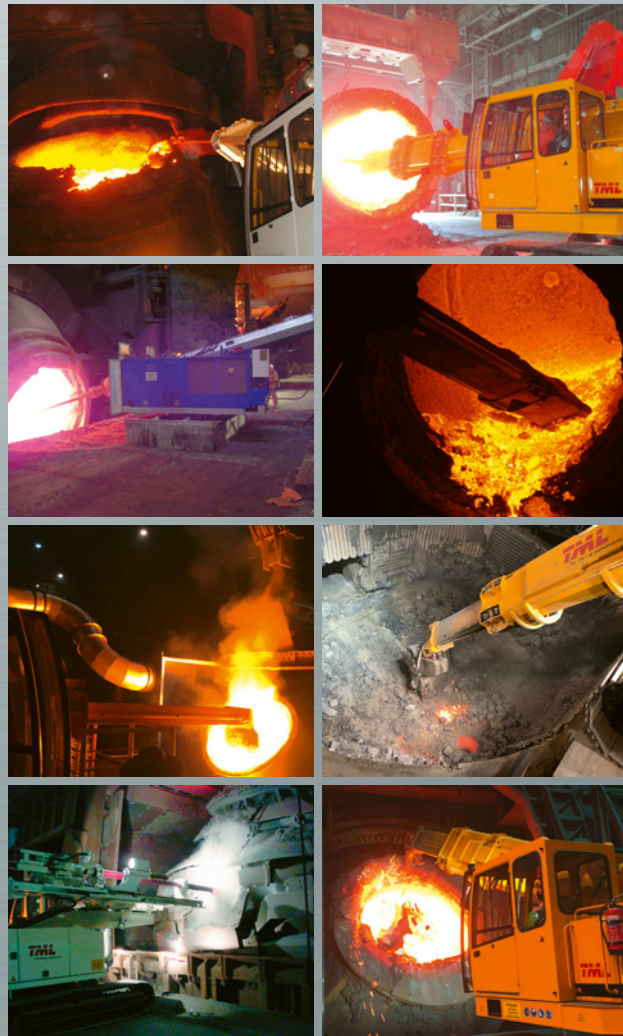
I SMS group

China**Erzhong produces first heat in new ESR plant**

INTECO recently produced the first heat in what is said to be China's largest ESR plant.

In November 2018, INTECO began installing a highly complex metallurgical 150 t ESR plant at Erzhong. The first heat was produced according to schedule in March 2019. The plant has two melting stations for ingots with up to 2,100 mm diameters.

I INTECO



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China

Daye Special Steel orders hydraulic open-die forging press



An identically designed open-die forge will be supplied to Daye Special Steel (Picture: SMS group)

SMS group has signed a contract with Daye Special Steel for the engineering and supply of a 50/60 MN, high-speed hydraulic open-die forging press.

The new press, to be installed in Daye's Huangshi plant, will be designed to operate with a forging force of up to 50 MN and an upsetting force of 60 MN in fully automatic, semi-automatic, or manual mode. 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. Commissioning is scheduled for May 2020.

| SMS group

China

Chengde Jianlong orders business analytics system

Special-steel long products manufacturer Chengde Jianlong Special Steel has contracted Danieli Automation to supply the Q3-Intelligence business analytics solution suite.

The Q3-Intelligence system, specifically designed for the metals industry,

will give Chengde Jianlong the ability to measure, through a comprehensive KPI library based on specific Danieli process know-how, all the performance figures of the technological processes of 13 individual plant processes, including steelmaking, casting and rolling.

The project, to be completed and commissioned in 18 months, is the first step of Chengde Jianlong's digital transformation strategy, jointly developed with the Danieli Automation DIGI&MET division.

| Danieli

China

Milestone in modern hot strip production: Shougang Jingtang starts endless rolling mill

Hot testing has begun for the Danieli Universal Endless (DUE®) hot strip mill installed at Shougang Jingtang United Iron & Steel in Caofeidian. The hot test of the slab caster started already in April.

At the new plant, a single line will be able to produce coil-to-coil and endless, thermo-mechanical and multi-phase as well as ultra-thin and thick products. Shougang Jingtang's DUE® plant will produce 2,100,000 t/year in

a wide mix of steel grades and strip dimensions from 0.8 to 12.7 mm thickness and widths from 900 to 1,600 mm.

| Danieli

China

Ningbo Powerway Alloy Material orders foil rolling mills

Ningbo Powerway Alloy Material has chosen Danieli Fröhling as supplier of

two new 20-high cold finishing mills for its third-phase expansion project.

To be installed in Ningbo, Zhejiang Province, the new 20-high cold finishing mills for Ning-

bo Powerway Alloy Material will be used to roll a wide product mix of copper alloys, from soft pure copper up to hard phosphor bronze. Strip dimensions will range from an entry thickness of 1.2 mm down to a minimum finish thickness of 0.03 mm, at a maximum strip width of 650 mm.

The core equipment for the twin-housing type mills will be manufactured at Danieli Germany workshops based on

Danieli Fröhling technology. They will be equipped with the patented intermediate-roll double bending system for improved strip flatness and direct hydraulic roll-gap control for high-precision thickness performance. The mills will be capable of using a wide range of work-roll diameters from 37 to 80 mm in order to achieve efficient and economic rolling performance.

The high-performance copper-alloy strip produced by Ningbo Powerway Alloy Material on the new mills will be mainly used for applications such as aerospace, high-speed trains, solar energy, and the telecommunications and electronic industry. Plant start-up is expected by the last quarter of 2020.

■ Danieli

China

Nantian Tool Steel issues final acceptance certificate for ESR plant

In the first months of 2019, two INTECO ESR plants were successively started up at Nantian Tool Steel.

After producing the first ingot with the 8 t electro-slag remelting (ESR) fur-

nace, at the end of February, another smooth first heat was produced with the second ESR unit of 16 t capacity. The latest generation plants are designed for high-quality, repeatable and most economical ESR production

in static mould, single electrode operation.

■ INTECO

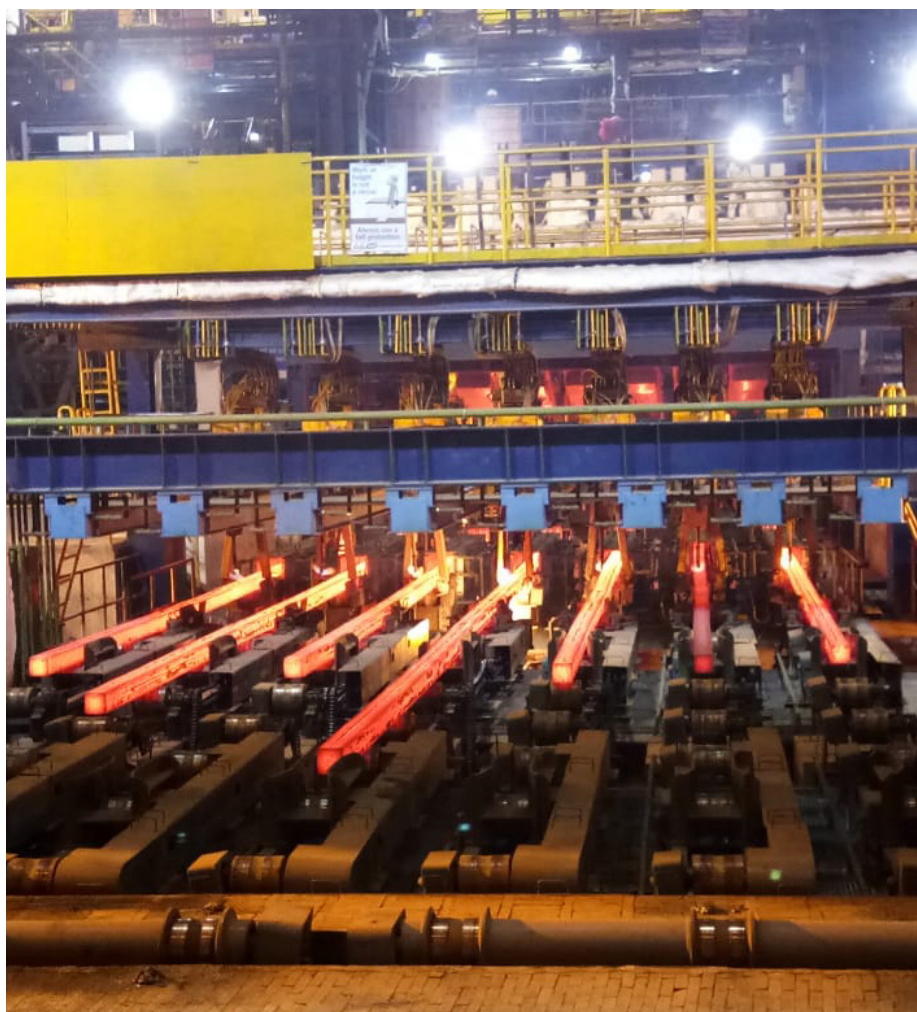
India

JSPL Angul starts up new combi-caster for billets and rounds

Jindal Steel & Power Limited (JSPL) and SMS group have successfully commissioned the high-speed seven-strand combi-caster installed at the Angul Odisha plant.

The combi-caster, supplied by SMS Concast, will produce low- and high-carbon, ball bearing and free-cutting steels. The casting formats include billets from 150 mm up to 200 mm square, with provision made for round sections from 162 to 220 mm diameters. Presently, JSPL Angul is casting 165 mm square billets. With this billet size and 100% open casting mode, the company can reach up to 2.3 million t/year of rebar grade products. In closed casting, the production capacity amounts to 1.8 million t/year. The scope of supply for the new caster included a ladle turret, tundish car with lifting and lowering device, CONVEX® mould tubes, electromagnetic stirrers and mould oscillators, overhead cross-transfer, turn-over cooling bed and automatic torch cutter. The combi-caster was commissioned within 12 months from project start.

■ SMS group



High-speed seven-strand combi-caster in operation at JSPL Angul (Picture: SMS group)

India

Hindalco Industries orders strip processing lines



Bridle rolls in an aluminium finishing line (Picture: Andritz)

Andritz has received an order from Hindalco Industries Ltd. to supply a new tension leveling line and a new degreasing line.

The tension leveling line will be designed for an annual capacity of 100,000 t and the degreasing line for a capacity of 150,000 t/year. They will be used for production of high-quality aluminium of the 3000, 5000 and 6000 series. The Andritz scope of supply comprises the lines including all mechanical and electrical equipment. Also commissioning of the lines, which is scheduled for spring 2021, is part of the order.

| Andritz Metals

Japan

Hitachi Metals grants final acceptance certificate for open-die forging press

SMS group has successfully commissioned the 90/108 MN open-die forging press at Hitachi Metals in Yasugi.

The plant, operating with a forging force of up to 90 MN and an upsetting force of 108 MN, produces flat and round bars from

ingots of up to 30 t starting weight. Two rail-bound manipulators position the forgings with millimeter precision and move them fully in sync with the press stroke. Hitachi intends to use the new open-die forging press to process temperature-sensitive materials, such as titanium alloys, tool steels, high speed steels, and nickel-based alloys. SMS group has devised a highly efficient, space-saving hydraulic system concept for the four-column, push-down press. High-speed forging is possible thanks to the 18 high-performance hydraulic pumps installed in the press. The twin pump arrangement, i.e. two pumps operated by one motor, makes the hydraulic system require distinctly less space. A three-dimensional laser measuring system measures the surface temperature and the geometry of the forging in real time, and optimizes the pass schedule for homogeneous forging of the core zone.

In order to minimize the vibrations emitted into the ground, the press was erected on a vibration-isolating foundation, consisting of an intermediate foundation and several vibration dampers. The horizontal stoppers installed on the sides give the solid press design extra stability in case of earthquakes.



The 90/108 MN open-die forging press in operation at Hitachi Metal's Yasugi Works (Picture: SMS group)

| SMS group

South Korea

Posco to modernize gas cleaning systems of BOF converters

SMS group, in cooperation with AERIX, South Korea, has been commissioned to modernize the gas cleaning systems of the three BOF converters at Posco's integrated steel mill in Gwangyang.

Within the scope of a production increase in the converter shop in Gwangyang, the gas cleaning systems are being adapted to deal with the higher process gas volumes. The project entails the extension of the dry electrostatic precipitators (ESP) for prima-

ry gas cleaning. Each of the gas cleaning systems will be rated for a capacity of more than 108,000 Nm³/h (dry). SMS group will provide all basic engineering services and supply the electrodes. The first and second electrostatic precipitators have already been extended. Extension of the third and last unit is scheduled for the end of 2019.

■ *SMS group*



Modernized gas cleaning system (Picture: SMS group)

Thailand

Sahaviriya Steel revamps skinpass mill

A revamp by Danieli Service of a skin-pass mill lubrication system has led to markedly reduced oil consumption at Sahaviriya Steel.

Danieli Service, in cooperation with Rebs Turbolub®, recently commissioned an oil-air lubrication system at Sahaviriya Steel's plant in Bangsaphan. This is the third skin-pass mill revamp performed by Danieli Service (Thailand) for Sahaviriya Steel. Danieli replaced the obsolete oil-mist system with

a modern oil-air Rebs Turbolub® system and modified the back-up roll chocks to allow optimal lubrication of the bearings.

The project has resulted in a reduction in oil consumption from 20 to 2 liters of oil/day, in addition to a much cleaner working environment due to the complete removal of the oil-fog produced by the old oil-mist system.

■ *Danieli*

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United Arab Emirates

United Iron & Steel commissions new cold mill complex



Single-stand cold rolling mill (Picture: Danieli)

Located in the industrial area of Abu Dhabi, the 250,000 t/year steel complex erected by Danieli provides excellent cold-rolled finished products for challenging markets.

The new plant of United Iron & Steel Company -UISC consists of an in-line push-pull pickling line, a single-stand cold rolling mill, and a continuous galvanizing line to process both hot and cold rolled coils. The push-pull pickling line can handle hot rolled coils with thicknesses between 1.6 and 3.2 mm and widths of up to 1,320 mm. Final cold rolled and hot-dip galvanized strip ranges between 0.2 and 2.0 mm thickness. A cut-to-length line and a cold-rolled slitting line complete the new plant. The push-pull pickling line will undergo capacity enhancements to process strip up to 4 mm thickness.

| Danieli

United Arab Emirates

Joint venture to set up new high bay container storage system in Dubai

Boxbay, an international joint venture formed by SMS group and DP World, will realize a new and intelligent high bay storage (HBS) system for the Dubai Expo 2020 world fair as a pilot plant.

The Boxbay joint venture brings longstanding experience in both container terminal logistics from DP World and knowhow

from Amova, an SMS group subsidiary, in high-bay metal product storage and handling. The patented design and rack structure of the system create unique advantages. As containers can be stored eleven stories high, the new technology can deliver the capacity of a conventional terminal in a third of the surface. The fully automated system has direct access to each con-

tainer, which means there will never be any unpaid and unproductive reshuffling. Furthermore, the Boxbay system brings significant gains in handling speed, energy efficiency, safety and a major reduction in operating costs.

| SMS group, DP World

Vietnam

Hoa Sen inaugurates second phase of its strip processing facilities

In April 2019, Hoa Sen Group organized an official ceremony to inaugurate the second construction phase of its plant Hoa Sen Nhon in the Binh Dinh Province.

For the new equipment installed at Hoa Sen, Tenova designed and supplied a new acid regeneration plant. The state-of-the-art acid regeneration plant reaches the highest environmental standard and

increases the efficiency and flexibility of the pickling process at Hoa Sen.

| Tenova

Austria

Breitenfeld Edelstahl starts up new ESR plant

The first successfully remelted ingot was presented approximately ten weeks after

INTECO had started erecting the new 30 t ESR plant for Breitenfeld Edelstahl.

The plant will further increase the ESR capacities of the Upper Styrian producer

of quality and premium steels. In addition to the existing two ESR plants and the VAR furnace, this unit is the fourth remelting facility in Breitenfeld's special steel plant.

Breitenfeld will also implement the process and production management system IMAS (INTECO Metals Application Suite).

It will integrate the four remelting plants for an holistically-optimized, reproducible and well documented production management and an increased level of digitalization.

■ INTECO



A third ERS plant will be installed at Breitenfeld Edelstahl (Picture: INTECO)

Austria

voestalpine Stahl replaces level 2 system in continuous slab caster CC8

All the continuous casters of voestalpine Stahl in Linz are now equipped with the same level 2 system from Primetals Technologies.

Since February 2019, a new level 2 process automation system from Primetals Technologies has been in successful operation on the CC8 continuous slab

caster in the Linz plant voestalpine Stahl. It replaces an existing system on the casting plant supplied by a third-party in 2018.

Using the same version of the level 2 system on all casters simplifies maintenance and enables the operating crews to be deployed flexibly at all of the casting plants. Furthermore, special metallurgical

models are now available at all casting plants. The CC8 continuous slab caster is designed as a single-strand top feeding plant and has an annual production capacity of 1.2 million t of high-quality steel grades.

■ Primetals Technologies

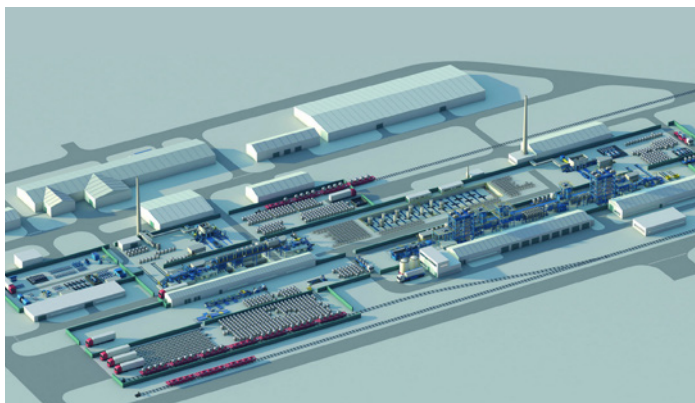
Belarus

MMPZ adds production planning system to complement new tinplate complex

MMPZ-group has awarded SMS group the order to supply an X-Pact® MES 4.0 production planning and control system for the new tinplate production complex built by SMS group at MMPZ's Miory location.

The tinplate complex comprises a reversing cold mill, electrolytic degreasing line, batch-annealing line, combined double reducing and skinpass mill, electrolytic tinning line and two packaging lines for sheet stacks and coils. Commissioning of the new works complex is scheduled to be completed in 2019.

MMPZ-group has decided in favour of the MES system from SMS group as it can smoothly be integrated into the X-Pact® automation for all plants within the works complex. It comprises planning, support and optimization, supply and dispatch, quality control and reporting functions. The



Model of the new tinplate complex for MMPZ-group (Picture: SMS group)



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scope of supply further includes an X-Pact® warehouse management system for the complete production complex. Integration of the MES system will make automation consistent from basis automation (level 1)

to process automation (level 2) and further to the production planning system (level 3). Also coil and sheet storage locations as well as cranes and transport vehicles will be integrated within the system. The

X-Pact® Automation system was supplied after it had passed an integration test.

■ *SMS group*

Czech Republic

Roll manufacturer Vítkovické Slévárny orders another lathe

Heinrich Georg Maschinenfabrik has received the third roll lathe order from Czech roll manufacturer Vítkovické Slévárny.

With the new machine, Vítkovické Slévárny will expand the capacity of its facilities in Ostrava, where two other Georg roll lathes of the ultraturn series have already been in

operation for several years. A novelty of the now ordered machine is its connectivity with the existing lathe supplied by Georg in 2013. This will allow both machines to be operated by just one person. Among others, the two machines will be equipped with cameras and monitors for the operator to be able to control both of them permanently and simultaneously.

The now ordered ultraturn lathe will be designed to machine up to 8,000-mm-long rolls with diameters of up to 1,550 mm and roll weights of up to 30 t. The 170 kW main drive achieves a maximum torque of 70,000 Nm. Like the two earlier machines, Georg will also supply the new machine complete with a dust extraction system and a cabin that protects the operator against flying metal chips. Supply of the new machine is scheduled for the summer of 2020.



The new lathe will be of identical design as the one supplied in 2013. (Picture: Heinrich Georg Maschinenfabrik)

■ *Heinrich Georg Maschinenfabrik*

Denmark

NLMK DanSteel continues investments in plate mill by ordering a new reheating furnace

SMS group will supply a 100 t/h walking beam furnace to be installed at the NLMK DanSteel plate mill located in Frederiksværk near Copenhagen.

The new furnace for the plate mill, also an original SMS supply, will be able to reheat a wide spectrum of slabs in the weight range from 3.1 up to massive 62 t for use in structural, shipbuilding, boiler and pressure vessel applications. In terms of material weights handled, this furnace will hence be the largest one ever built by SMS group. The scope of

supply includes roller tables for slab handling, a modern water treatment plant with energy recovery system, which uses the energy from the furnace for internal and external heating purposes, and integration of a level-2 automation system. Commissioning and start-up are scheduled for the beginning of 2021.

Meanwhile NLMK has begun hot testing of the accelerated cooling system also supplied by SMS group. The new equipment will fundamentally change the company's product mix and increase the share of niche plate, including for offshore wind power

generation and pressure vessels. The new accelerated cooling system is in-line with the hot-rolling mill. After rolling to the final thickness, the plate is fed into the cooling system and cooled rapidly with water under controlled conditions. Thermomechanical rolling allows the production of plates with improved weldability while improving the strength and toughness. Improved weldability is especially important in the production of underwater foundations of wind towers that operate in aggressive maritime environments. The new cooling system will boost the production of niche premium plate from the current 0.1 million to 0.35 million t.

■ *SMS group*

Representatives of NLMK Europe, NLMK DanSteel and SMS group after signing of the furnace contract (Picture: SMS group)



Germany

Successful business year 2018 for Saarlühl Group

The Saarlühl Group looks back on a successful business year 2018 which was characterized by a further increase in sales revenues and favourable figures in the financial result.

The production of crude steel remained unchanged on a very high level and reached 2.782 million t in 2018 compared with 2.785 million t in the previous year. The sales volumes of Saarlühl AG (wire rod and bar steel) fell by 4% to 2.431 million t (previous year: 2.532 million t).

Tim Hartmann, chairman of the management board and chief financial officer explained the figures for the year: "Thanks to high demand in our core segments of bar steel and wire rod, the group turnover increased to a record level compared with the previous year due to a positive development in revenue and in spite of a slight decrease in shipping volumes." The steel market for wire rod and bar steel products which is relevant for Saarlühl AG continues to be characterized by over-capacities so that there is still a high degree of pressure on volumes and prices.

At Saarschmiede, after completion of restructuring measures, the business year 2018 was characterized by orientation towards new business fields – such as mechanical engineering, special materials, tool steel – and consolidation in the field of power generation machinery. The situation on the forge market

also continued to be extremely tense in 2018. The workforce was reduced by half at the end of 2017 using socially compatible measures to its current level of 430 employees.

I Saarlühl

Finland

SSAB Hämeenlinna receives quality management certification

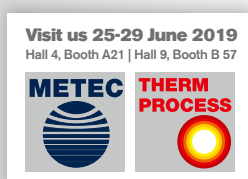
SSAB has received IATF 16949:2016 certification for its Hämeenlinna operations.

Certification according to IATF 16949:2016 defines the requirements of a quality management system for organizations in the automo-

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tive industry. Maintaining certification is a continuous process as there will be a new audit every year. SSAB Hämeenlinna supplies premium products to customers in the automo-

tive industry. These products include ultra-high strength galvanized steel, which among other things is used in the manufacture of car safety components. The Hämeenlinna Tube Mill and

SSAB Borlänge in Sweden already have this certification.

■ SSAB

Germany

Salzgitter and Tenova sign MoU for pursuit of hydrogen-based steel production

Realization of SALCOS (SALzgitter Low CO₂ Steelmaking) is going to be continued as agreed by the cooperating partners Salzgitter AG and Techint Group company Tenova.

SALCOS is a new concept for a significantly CO₂-reduced steel production, commonly developed by the two companies. The aim is to undergo a stepwise

transformation process of the integrated steelmaking route, moving from carbon-intensive steel production based on blast furnaces towards a direct reduction and electric arc furnace route, including the flexible incremental utilization of hydrogen. This concept is capable of reducing CO₂ emissions by up to 95% with respect to the entire steel production route. The cooperation aims at joint-

ly applying for public funding of the SALCOS project. In this context, Tenova will provide the Energiron-ZR-direct reduction technology, the HYL direct reduction technology with integrated CO₂ absorption system, jointly developed by Tenova and Danieli.

■ Salzgitter AG, Tenova

Italy

Arlenico starts production of quality wire rod on new sizing block

A new four-stand MEERdrive®PLUS sizing block supplied by SMS group has been successfully integrated into the existing Caleotto wire rod line.

With the new four-stand MEERdrive®PLUS sizing block, Arlenico, a special quality wire

rod producer located near Lecco Lake, is now able to serve the market with products of much tighter tolerances than before, as the company can now also apply thermomechanical rolling. Since the first rolling trials, the tolerances as low as 0.05 mm and 50% ovality have been fully met

on 5.5 mm diameter product. The technologies supplied by SMS group include a high-tech water cooling line of the latest design and the level 2 automation system.

■ SMS group

Italy

Tenova and ORI Martin launch lighthouse plant "Acciaio_4.0"

Tenova and ORI Martin have presented their joint project to create a cyber physical factory by integrating the enabling technologies of Industry 4.0 within the steelmaking process.

"Acciaio_4.0" aims to develop a cyber physical factory that, thanks to Industry 4.0 technologies, will allow the vertical, horizontal and transversal integration of the entire steelmaking process. In the

project, ORI Martin is system integrator of Industry 4.0 technologies, transforming its steel plant in Brescia into a smart factory that has the ambition of becoming an innovation model in the sector. Tenova, as industrial technology partner, works to design innovative models of integrated process control for the plant, using smart sensors (IoT) and gathering data in cloud systems to develop applications of machine learning, remote support and pre-

dictive maintenance, while giving great consideration to environmental sustainability, operator safety and data security. In addition, the project has the objective to establish a network with academic and research institutes as well as with highly specialized small and medium-sized enterprises.

■ Tenova

Europe

ArcelorMittal to temporarily reduce European primary steelmaking production

Due to the combination of weakening demand, rising imports coupled with insufficient EU trade protection, high energy costs and rising carbon costs, ArcelorMittal has decided to temporarily cut annualized European primary

steelmaking production by 3 million t.

The idling of production affects its steelmaking facilities in Krakow, Poland, and reduces production in Asturias, Spain.

In addition, the planned increase of shipments at ArcelorMittal Italia to a 6 million tonnes annual run-rate will be slowed down following a decision to optimize cost and quality over volume in this environment.

Commenting, Geert van Poelvoorde, CEO, ArcelorMittal Europe – Flat Products, says: “These actions reflect the weak demand environment in Europe today, a situation further compounded by increased imports despite the safeguard

measures introduced by the European Commission. High energy costs and increasing carbon costs are adding to the tough environment. Despite the introduction of the permanent EU safeguard tariffs in February 2019 there has been a contin-

ued and consistent rise in flat steel imports into Europe.”

■ *ArcelorMittal*

Europe

ArcelorMittal to sell steelmaking assets to Liberty House

The European Commission has approved the sale of several European steelmaking assets by ArcelorMittal to Liberty House Group.

The assets form a divestment package ArcelorMittal agreed with the European

Commission during its merger control investigation into the company's acquisition of Ilva S.p.A. Assets included within the divestment package are ArcelorMittal Ostrava, Czech Republic, ArcelorMittal Galati, Romania, ArcelorMittal Skopje, Macedonia, ArcelorMittal Piombino, Italy, ArcelorMittal

Dudelange, Luxembourg, and several finishing lines at ArcelorMittal Liège, Belgium. Transaction closing is anticipated to occur before the end of the first half of this year.

■ *ArcelorMittal*

Poland

Cognor to revamp reheating furnace

Cognor has contracted Fives to revamp the pusher-type reheating furnace at its Krakow plant, with the aim to improve furnace performance, both in terms of availability and operational cost reduction.

The furnace is part of a rolling mill producing merchant bars and rebars. During the last few years, it had become increasingly difficult to operate at the designed production rate. The furnace also required fre-

quent maintenance and consumed excessively gas.

A technical constraint of the planned revamp is the fact that the furnace dimensions have to remain the same, as part of the furnace foundation cannot be modified. Fives proposed a solution that would solve this problem. Fives will use its proprietary combustion system AdvanTek® technology, which separates the burner capacity control from the flame length control. It operates the burners at any produc-

tion rate and operating conditions at the optimum capacity. Five's scope of work also includes refractory repairs and repairs of the steel structures of the soaking zone. Site work is planned to start in March 2020 with the first hot product being processed in the second quarter of 2020. The project will be executed by a Fives subsidiary in Spain.

■ *Fives group*

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SN Seixal to upgrade bar mill

The Megasa Group company places independent orders with plant suppliers Danieli and SMS group

Danieli is going to modernize the rolling mill with a new ERW welding machine and new intermediate and finishing stands. The new EWR welding machine will feed the existing bar/spooler lines in endless mode, starting from square billets of 140, 150 and 160 mm at a rate of the 210 t/h. The line will feature an innovative spark killer system which will collect more than 70% of spatter material generated during the flashing/welding cycle.

The installation of the welder will enable SN Seixal to customize the weight of wire rod and spooled bars in coils.

The project is scheduled to be implemented during a period of one-and-a-half months in the summer of 2020, including civil works, installation and start-up activities shutdown.

SMS group to supply new walking beam reheating furnace

The new walking beam furnace, rated at 160 t/h cold charged and 210 t/h hot

charged, will include burners of the ZeroFlame design and latest technological packages developed by SMS group for level 2 and combustion management. The combination of these features provides reduced NO_x emissions down to 90 mg/Nm³, less scale formation down to 0.4%. Start-up is scheduled for the end of summer 2020.

| Danieli, SMS group

Russia

AEMZ and NPZ to install new wire rod mills

Danieli has received orders from AEMZ - Abinsk Electric Steel Works and NPZ - Novorossiysk Rolling Plant each for H3 wire rod mills.

The mill ordered by AEMZ will be designed for 600,000 t/year. It will produce wire rod in coils for construction purposes, welding wire and CHQ grades. The product dimensions will range from 5.5 to 16-mm-dia smooth rounds and 6

to 12-mm-dia quenched and microalloyed rebar.

NPZ ordered a new 500,000 t/year H3 wire rod mill to roll 150 x 150 mm billets down to 5.5 to 16-mm-dia wire rod and deformed wire rod in coils weighing up to 2.1 t. Installation and start of production will take place in 2020.

The Danieli H3 mills can operate at over 100 m/s. They consist of ESS (Energy Saving System) cantilever-type and

SHS housingless stands and high-speed finishing blocks. The Danieli structure control system includes a water-cooling line for wire rod quenching and controlled cooling. Perfect coil forming is provided by an oil-film bearing loop-laying head, rotary reforming tube and easy-down system.

| Danieli

Russia

MMK-METIZ to expand annealing capacity for wire coils

Tenova LOI Thermprocess has received a follow-up order for HPH® bell-type furnace technology.

MMK-METIZ located in Magnitogorsk, Chelyabinsk region, already operates an HPH® bell-type furnace plant supplied by Tenova LOI Thermprocess in 2014. This

plant consists of two annealing bases, one heating hood and one Jet-cooling hood with a maximum net charge weight of 36 t of wire rod or drawn wire coils. It uses a hydrogen/nitrogen mixture as protective gas atmosphere and features a useable diameter of 3,200 mm and a useable height of 2,700 mm. The con-

tract is about the expansion of the existing plant by two further annealing bases, one additional heating hood and one Jet-cooling hood. Production start of the new plant is scheduled for the beginning of 2020.

| Tenova LOI Thermprocess

Russia

MMK to modernize blast furnace cooling system

As part of its development strategy, MMK will conduct a complete overhaul of its No. 2 blast furnace in 2020. The project will be performed by Paul Wurth.

In this project, Paul Wurth will help MMK define the profile of the modernized furnace by considering the raw materials base and

process conditions of the customer. Detail engineering will be provided for the high-heat loaded bosh and belly areas, cooling elements and primary cooling system. Paul Wurth will also supply horizontally arranged copper cooling plates, highly conductive graphite refractory bricks and ramming mass. A complete set of electrical instrumentation

and control equipment for the dedicated pump house with heat exchangers and the related cooling circuit will be part of the supply. On-site supervision will also be performed during pre-shutdown and shutdown periods until commissioning.

| Paul Wurth

Russia

NLMK Group announces new corporate strategy

NLMK Group with operations in Russia, the USA, and the EU, has launched its new Strategy 2022.

Strategy 2022 is based on enhancing NLMK Group's competitive advantages. Through operational efficiency initiatives and investment projects, as well as debottlenecking steelmaking operations, steel output at the Lipetsk site will increase by 1 million t/year. Steel output growth will be 100% covered by captive iron ore from Stoilensky.

Added steel output will be sold in the form of premium and niche high value-added products. Target growth in sales of these products will total 1.7 million t, driven by investment into the group's rolling operations in Russia, Europe and the USA.

As part of its strategic goal on sustainable development, NLMK will continue to execute its target programmes aimed at reducing its environmental footprint, improving occupational health and safety, and reducing the injury rate.

Pelletizing capacity to increase

Stoilensky, the second largest producer of iron ore concentrate in Russia, has signed a development contract with the Finnish company Outotec.

Under this contract, the pelletizing plant's installed capacity will be increased by a third - from 6 million to 8 million t/year of pellets. Outotec experts will design, supply main equipment and automation systems, and provide consulting support during installation and commissioning of the equipment. The project is scheduled for completion by the end of 2020.

Additionally, the company plans to boost ore production and beneficiation capacity by 14% by 2021 via upgrades of Stoilensky's other transformation stages with a view to ensure stable supply of raw

materials to the pelletizer after it reaches the output of 8 million t.

Steel Tree programme

In the two years of the Steel Tree programme launched by NLMK as many as 33 community-oriented projects have been completed in Lipetsk, Zarinsk and Sary Oskol.

In 2019, company employees in all major home regions in Russia will have an opportunity to compete for grants offering funding for environmental projects, landscaping and welfare improvement initiatives.

During the past two years, over 5,000 people participated in these initiatives. The programme gave an opportunity to clear public areas of garbage, renovate public gardens and city parks, plant trees, install interactive bins for waste sorting, set up special areas for sports, art and environmental research, and create symbolic works of art. Medical equipment was purchased for the Lipetsk regional out-patient clinic for drug addicts, which enables early detection of drug addiction in teenagers.

NLMK localizes Steeluniversity for Russia

Steeluniversity is an educational project of the World Steel Association, an international association of steel producers. It is a collection of e-learning resources and inter-

active simulations covering major aspects of iron, steelmaking and rolling operations.

The website localization for the Russian-speaking audience began two years ago on the initiative of NLMK Group's Corporate University. Experts of the company organized the translation of the website itself, its educational games and 3D-models. A number of training e-courses are being finalized and will be added to the website as soon as they become available. The website will be constantly updated, and new programmes and simulations will be added to its collection. The Steeluniversity website is intended for use by steel companies and industry-specific educational institutions. It is also available in English, Chinese and Spanish language.

NLMK



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Spain

Sidenor Basauri to upgrade walking beam furnace

With a comprehensive upgrade, Sidenor Basauri is going to increase the capacity of its reheating furnace from currently 85

to 130 t/h. The project will be handled by SMS group.



After the upgrade, the walking beam furnace at Basauri will have a capacity of 130 t/h
(Picture: SMS group)

The furnace, supplied by SMS group in 2016, had been designed with the provision for a future capacity increase. All civil and mechanical modifications had already been taken into consideration to guarantee a short plant shut down and a fast restart.

The furnace reheats special steel blooms in sections between 185 and 240 mm square. SMS group's range of supply for the upgrade will include new steel structures with a set of SMS ZeroFlame extra-low NO_x burners. These burners had already been included in stage 1 reducing pollutant emissions to less than 100 mg/Nm³ at 1,250°C. Start-up after the upgrade is scheduled for the second half of 2020.

| SMS group

Turkey

Erdemir orders slab inspection and grinding equipment

Danieli Centro Maskin is going to supply a complete inspection and conditioning plant to Erdemir.

The new slab inspection and grinding plant will be set up at Erdemir's site in Zonguldak. It will be designed to pro-

cess approximately 400,000 t/year of slabs in ultra-low, low and medium carbon steels as well as alloy steel grades.

The grinding plant will consist of a SuperGrinder and a lateral unit for edge and corner grinding. It will come with the HiGrind digital system for grinding depth control, the E-Cube system for grinding at variable, stepless angles, and the Cast-t-Grind system for processing hot slabs of up to 800°C. Danieli's IntelliGrind system will ensure automatic detection and classification of surface defects by artificial intelligence and training of the neural network.



Shake-hands after signing the order for Erdemir, which is part of the Oyak Group
(Picture: Danieli)

| Danieli

Turkey

Isdemir orders 200 t RH plant

INTECO has been commissioned by Isdemir, part of the Oyak Group's Mining & Metallurgy division, to supply a new RH plant.

The new 200-t RH plant will be supplied complete with all necessary auxiliary equipment

required for steel refining at the highest quality level. These include wire feeding machines, a top lance and manipulators for temperature measurement and sampling. A material management system, in which each bunker is individually weighed, will supply the plant with the necessary alloys and aggre-

gates. INTECO will also supply a treatment station and a powder feeding station. Commissioning of the plant is scheduled to take place in spring 2021.

| INTECO

Turkey

Kardemir starts up off-gas cleaning systems

Meros off-gas cleaning plants supplied by Primetals Technologies are now in operation at Kardemir's Nos. 1, 2 and 3 sinter plants.

In December 2018, a Meros off-gas cleaning plant supplied by Primetals Technologies was started up at sinter plant No. 3, followed by Meros plants for sinter plants No. 1 in early February and No. 2 in early March. Each plant is able to treat 400,000 Nm³/h of sinter off-gas, reducing SO_x by more than 90% as well as delivering extremely low dust emissions. All the three Meros plants use sodium bicarbonate as desulphurization agent. Primetals Technologies was responsible for the engineering, supply of key equipment, electrics and automation as well as for advisory services for cold and hot commissioning.



Off-gas cleaning plant at Karabük Demir Çelik Sanayi ve Ticaret A.Ş. (Kardemir) (Picture: Primetals Technologies)

■ *Primetals Technologies*

Turkey

Tosyali Toyo builds new continuous galvanizing line

Tosyali Toyo has granted Danieli the final acceptance certificate for its new continuous galvanizing line.

The 200 m/min line features the latest-generation X-Jet gas wiping system, ensuring highest coating uniform-

ity over the whole range of thicknesses (0.2 - 3.0 mm, hot rolled and cold rolled material). The Danieli skin pass and tension leveller provide excellent flatness and roughness characteristics. The supplied Danieli Centro Combustion furnace for high-temperature annealing

and rapid cooling includes low-inertia radiant-tube heating and a direct-firing zone applying low-NO_x/CO burner technology.

■ *Danieli*

United Kingdom

Tata Steel restarts blast furnace at Port Talbot after revamp

A revamp carried out by Primetals Technologies has extended the useful life of blast furnace 5 at Port Talbot, Wales.

The major areas of work included the replacement of a ring of the furnace shell, replacement of cooling elements inside the shell, partial replacement of the carbon hearth refractories, the waste gas downcomer replacement, further shell modifications as well as general furnace lining repairs. Primetals Technologies was involved in the design of the replacement parts, stress analysis of these items, lifting stress calculations, construction engineering, construction plan-

ning and temporary works calculations. Before the revamp, the blast furnace had been running for 15 years, producing some 30 million t of iron.

■ *Primetals Technologies*

Blast furnace 5 at Tata Steel, Port Talbot in South Wales was relit in January 2019 after a comprehensive revamp (Picture: Primetals Technologies)



The Bright World of Metals 2019

Digitalisation means dematerialisation

Established companies offer the greatest potential for digital transformation. However, experts are noticing that established companies are still targeting new growth through new services too rarely. It is precisely here that traditional companies and start-ups can learn from each other successfully. Examples of successful digital transformation are being presented at the metallurgical trade fair METEC from 25 to 29 June 2019 in Düsseldorf, Germany.

In the digital transformation age, established companies are starting to take new approaches from the start-up community seriously too. A current example of this is design thinking, which is considered to be the epitome of creativity, e.g. at SMS group, the metallurgical plant manufacturer.

The long-established company is well known all over the world for the technical perfection of its machines and equipment for the production and processing of iron, steel and non-ferrous metals. For a long time now, technologies like virtual reality, augmented reality or digital twins have been proven instruments in the planning, design and construction of new steel mills, with which SMS applies German engineer-

ing skills to create machine technology of the highest quality, including electrics and automation – more recently with the help of such innovative production methods as additive manufacturing too. What is new, however, is that the machine and plant manufacturer is developing digital products and services to an increasing extent. When it launched SMD Digital in May 2016, the technology company provided itself with a start-up that gives customers from the steel and non-ferrous metal industry the appropriate tools for digital transformation. Such as software for “Industry 4.0” solutions and apps for the metal industry, which are made available via the in-house platform mySMS group. SMS group is planning to present new dig-

ital services and products at the forthcoming metallurgical trade fair METEC 2019.

As software developers with a digital mindset, the staff of SMS Digital in Düsseldorf, the city on the Rhine, are keen, entitled (and required) to live a different corporate culture than the technicians in the SMS mechanical workshop in the Siegerland, where regular working hours, time clocks and works councils are standard features of everyday operations in the industrial age. The approach adopted by the software developers is very different from the classic method of operation used by the engineers. In design thinking, development starts with the customer and his problem rather than with a meticulously compiled set of specifications. A user-



More than 70,000 visitors are expected to attend the world's leading trade fairs for foundry and metallurgy technology GIFA, METEC, THERMPROCESS and NEWCAST from June 25 to 29 (Picture: Messe Düsseldorf)

based approach involves validation of ideas interactively between the digital unit and the customer, before a prototype is selected to be optimised for large-scale introduction. Once the idea has been turned into a marketable solution, it can be included in the parent company's programme. The digital unit was not established on an exclusively internal basis, however. The Munich business consultants etventure helped to structure SMS Digital and acted as a kind of "matchmaker" in the successful marriage between the "old" and "new" economies.

VDMA Metallurgy: focus on companies' overall digital strategy

Kathrin Delcuve is the expert responsible for innovation and technology development at the VDMA Metallurgy trade association. When she talks about "Industry 4.0" and IoT, what she means are instruments for digital transformation of (and in) industrial production. She explains: "For process-based metallurgical production technologies, it was crucial first of all to be able to improve process and quality control by taking advantage of big data methods". The clear objective was to be in a position to offer customers energy and cost savings in the production process and this continues to be the case now too. As an example, the VDMA expert mentions the use of data mining processes to improve the correlation of machine data and process parameters. This enables prediction models to be developed – in metal industries, for example, for temperature regulation, more precise loading or the prediction of melting endpoints.

Delcuve goes on to specify: whereas the initial emphasis in "Industry 4.0" activities was mainly on process optimisation projects, the entire company is now becoming the focal point to an increasing extent. The VDMA expert says: "In the meantime, successful corporate exploitation of "Industry 4.0" potential is no longer determined by product and application optimisation in the production process alone; what is decisive instead is how individual, data-based innovations are incorporated in the company's overall digital strategy". Solutions for controlling and optimising production processes, such as sensor technology, data analytics, VR or AR technologies, make smart operations – and, as a result, data-based services and distinctive products – possible. According to Delcuve, implementation is frequently carried out in-house and along the lines of product development processes in start-ups. But also in co-operation with start-ups, which have based their business models on Internet-based applications and software services. In September 2018, for example, VDMA brought selected start-ups together with companies from the metallurgical machine and plant manufacturing field at the Dortmund Technology Centre.

Kathrin Delcuve summarises the progress made: "In the meantime, digitalisation encompasses all levels of production and value creation – product development, customer relations and the competitive positions in supply chains and B2B business". Her conclusion: "In the meantime, successful corporate exploitation of "Industry 4.0" potential is no longer determined by product and application optimi-

sation in the production process alone; what is decisive instead is how individual, data-based innovations are incorporated in the company's overall digital strategy".

At GIFA, METEC, THERMPROCESS, NEWCAST, the VDMA Metallurgy trade association will be highlighting numerous examples of applications from its corporate members, including a new edition of the brochure "Industry 4.0 in metallurgical plant manufacturing".

Klößner: pioneer that has had to overcome initial difficulties

The steel distributor Klößner & Co. is considered to be one of the digitalisation pioneers in metal industries. CEO Gisbert Rühl studied the successful models adopted in the platform economy in detail and visited start-ups on-site in Silicon Valley. A particularly close examination was made of Amazon. Back in Germany, the steel distributor established the digital unit kloekner.i in Berlin. Rühl recalls the initial difficulties that were experienced when implementation of the digital strategy began: "A major obstacle proved to be the necessary change in our corporate culture. Because our aim right from the start was to win all our staff over and motivate them to support the process of change. This is the only way for digital transformation to be carried out successfully." Rühl eliminated the internal communication barriers and ended the hierarchically organised information flow. According to Rühl, staff and their superiors now communicate non-hierarchically via the internal social network Yammer. "Another of the bigger problems was most definitely initial scepticism



Burkhard Dahmen (Picture: SMS group)

Burkhard Dahmen elected new president of METEC 2019

Burkhard Dahmen, Chairman of the Managing Board at SMS group GmbH, is the new president of METEC, the international metallurgy trade fair with congresses, which takes place from June 25 to 29, 2019. Born in Düsseldorf, Burkhard Dahmen was appointed in April at the executive board meeting of the trade fair quartet GIFA, METEC, THERMPROCESS and NEWCAST. "This year's METEC has a particular trend-setting significance due to the dramatic upheavals in our industry. For some years now, megatrends such as digitalisation, Industry 4.0, additive manufacturing and responsible use of natural resources have dominated discussions among steel manufacturers and processors as well as their suppliers on a daily basis," says Burkhard Dahmen, summing up current challenges.

about the digital tools developed by the digital unit in Berlin. This meant that we needed to integrate kloeckner.i in the group more effectively, so that the classic side of our company gives active support to introduction of the digital tools. Our exchange programmes between staff from the classic operations and our digital unit have proved to be thoroughly effective here and have helped to establish a digital mindset in the core organisation".

Rühl stresses that the digitalisation strategy has reached all areas of the group in the meantime. "We are digitising not only the front ends to customers but also to an increasing extent the internal processes of Klöckner & Co., in order to become even faster and even more efficient. It is, however, also correct that our digital unit kloeckner.i in Berlin is the 'hot-bed' of digitalisation within the group. Digital natives work there on our solutions for digitalisation of the entire Klöckner & Co. supply and service chain – on behalf of all the company's locations and in close liaison with group colleagues and customers."

The strategy has proved successful: "Klöckner & Co. currently generates about a quarter of sales via digital channels. This corresponds to annual digital sales of some EUR 1.5 billion", as Christian Pokropp, Managing Director of kloeckner.i, adds. Although this is already a large percentage compared with com-

petitors and companies in other industries, Klöckner does not intend to rest on its laurels. Pokropp promises: "We aim to increase the figure to 60 per cent by 2022".

Digitalisation has become an area of operation of its own with digital consultancy services. New digitalisation projects are also on the agenda. "We are currently expanding the Klöckner & Co. online shops, which are available in six countries in the meantime, into marketplaces", says Pokropp. He adds that Klöckner has convinced distributors of complementary products about the benefits of its platforms. These companies now distribute products that supplement the Klöckner & Co. product portfolio via Klöckner's own online shops with marketplace functions. Pokropp explains: "In view of the good progress made in the digitalisation of Klöckner & Co. and increasing numbers of inquiries, kloeckner.i will also be providing digital consultancy services to external companies in future. We are in addition enabling consultancy customers to start e-commerce operations simply via integration in Klöckner & Co.'s proprietary B2B marketplace".

Digitalisation means dematerialisation

What traditional companies often get wrong or misunderstand: "Digitalisa-

tion does not mean abandoning old strengths that have made the company great", as Philipp Depiereux, founder and director of the digital consulting company etventure points out. In his opinion, at German companies these strengths are, above all, engineering skills, precision, perfection, many years of industry experience and an established customer base. The digital expert says: "The 'Made in Germany' quality slogan still applies in the digital age too". He emphasises that companies need, however, to continue developing and to adopt the successful formulas implemented by digital players too: speed, data expertise and an uncompromising focus on the customer and user. The conclusion drawn by the expert for digital transformation, who is very familiar with heavy industry due to the consulting services he has provided to Klöckner and SMS: "Whoever manages to combine old strengths with new ones will be successful in the digital age too". With the systematic implementation of their digital strategy, companies like Klöckner and SMS can be considered to be something like the digital avant-garde in the metal industry.

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The steel congress at the METEC fair

4th ESTAD – European Steel Technology and Application Days

In 2019, the Steel Institute VDEh will once again be organizing the accompanying technical congress of METEC. The top-class event with more than 660 lectures will take place from 24 to 28 June at the Congress Center of Messe Düsseldorf.

“The steel industry has to remain one step ahead and continuously needs to move forward. The METEC and the 4th ESTAD will give answers to many of the pressing technical questions at hand and will therefore contribute to the further success of steel in Europe and in the world.”

Prof. Dr.-Ing. Wolfgang Bleck

Only those who develop their company further will remain competitive. A prerequisite for this is constant information about the latest and most sophisticated technological progress, the exchange of ideas and networking with customers, business partners and research institutes. The European Steel Technology and Application Days (ESTAD) congress, which takes place parallel to METEC, offers very good opportunities for this. The Steel Institute VDEh and its partners offer visitors the perfect opportunity to achieve their goals.

At this event attendees will receive up-to-date information on new ideas and

developments as well as on the state of metallurgical process technology for iron and steel production, steel materials and steel applications.

Extensive programme with more than 660 presentations

Speakers and co-authors of the 4th ESTAD have prepared the lectures of the congress with much commitment. In addition to the organizing committee headed by the Steel Institute VDEh, a scientific advisory board consisting of about twenty renowned experts from industry and science compiled the top-

class programme of the 4th ESTAD. The range of topics covers the most important technologies and latest developments in iron and steel production as well as steel materials and their applications. More than 660 lectures in 150 technical sessions within three days, from 25 to 27 June 2019, will cover the following areas:

- ironmaking,
- steelmaking,
- rolling technologies,
- steel materials and their applications, surface technologies, additive manufacturing,
- environmental and energy aspects, and

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in addition to all aspects of digitalization and Industry 4.0.

"Today, EU policies request drastically reduced CO₂ emission levels by the year 2050, which is a challenge for the steel industry to achieve with the existing iron and steelmaking processes. New technologies need to be developed", says Prof. Dr.-Ing. Wolfgang Bleck, chairman of ESTAD 2019 and chair of ferrous metallurgy at RWTH Aachen University. "Steel, with its manifold applications, is a CO₂ mitigation enabler, but must also compete with other materials currently on the market or in development. The steel industry has to remain one step ahead and continuously needs to move forward. The METEC and the 4th ESTAD will give answers to many of the pressing technical questions at hand and will therefore contribute to the further success of steel in Europe and in the world", Wolfgang Bleck continues.

For forty years, technical congresses have accompanied METEC

METEC was founded in 1979 and has been held in Düsseldorf ever since. At the first METEC already, the Steel Institute VDEh, in close cooperation with Messe Düsseldorf, organized the accompanying metallurgical congress.

In 2013, the Steel Institute VDEh proposed a new European event, the European Steel Technology and Application Days (ESTAD), which is open to steel producers, steel consumers, plant suppliers, research institutes and universities from all over the world. ESTAD is staged in cooperation between the Austrian Society for Metallurgy and Materials (ASMET), the Swedish Steel Producers Association (Jernkontoret), the Italian Associazione Italiana di Metallurgia (AIM) and the German Steel Institute VDEh.

The first ESTAD took place in April 2014 in Paris, France, the second together with METEC in June 2015 in Düsseldorf, Germany, and the third in June 2017 in Vienna, Austria.

The 4th ESTAD will take place parallel to METEC 2019, starting with a get-together on the evening of June 24 and ending with plant tours on June 28. During this time, participants will have the opportunity to attend numerous lectures on the latest technical developments in the world of steel. The opening and plenary sessions of ESTAD will take place on the morning of 25 June 2019.

The complete lecture programme and much more information about the event can be found on the congress homepage. There you can also register online.

www.metec-estad2019.com



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New software analyzes signals from slag detection sensors in steel mills

Slag readings are now available factory-wide thanks to the new Amepa Report software which automatically analyzes the measured values of the slag detection sensors in the steel mill using new methods of digital signal processing and automatically evaluating the data based on rules. On casting ladles, measured values deviating from the nominal values are detected very quickly, for example in the area of the well block, upper nozzle or slide gate. This is done without having to take the time to track individual value curves. This evaluation can also be used to schedule maintenance work.

More than 300 systems of the Amepa electromagnetic slag detection system ESD are already in use in steelworks on ladles and converters worldwide. These systems report an alert as soon as there is a danger that the slag produced in each process step will be transferred to the next vessel. All status messages are presented to the steelworker in table form, and the measurement results in graphic form. The results can be sent automatically to previously configured user groups as shift or daily reports in the form of e-mails at specific times.

As part of the increasing cross-process networking, the system stores measurement data and system results in a database. Detailed data, current and historical, is available to users in their company-wide network. In addition, a web server makes contents of the database available within the customer network which can be accessed at any time with standard web browsers. Thus, the Amepa Report software makes data about accompanying slag available to different user groups at any time in an adapted visualization.

The software allows the user to adapt the parameters of the ESD system to the user's product range. Remote maintenance and access to data for online customer support by Amepa specialists are also available. The new software can be used for existing slag detection systems, ESD 100 S and ESD 200 from model year 2010. In this way, customers with older systems can benefit from the advantages of development in digital evaluation.

I Amepa
Hall 5, stand F20



The Amepa Report software makes data on accompanying slag available to different user groups within the customer network at any time in a customized form
(Picture: Amepa)

Bulk material transport solutions for the iron and steel industry

Aumund are specialists in handling hot or cold, abrasive and chemical reactive bulk material. It provides solutions for horizontal, inclined or vertical conveying, transport and extraction of any kind of bulk materials under difficult conditions and in continuous operation. For the different process stages in iron and steel plants Aumund supplies solutions and products for conveying, storing, extracting, feeding and blending of coal, iron ore and limestone; cleaning of raw material and coke ramps as well as silo or bin discharging;

conveying of DRI, HBI, HCl, Fe-pellets, Fe-sinter and coke of up to 1,100°C; conveying in inert atmosphere or seal gas; conveying and smooth cooling of HBI; additional cooling of Fe-pellets or Fe-sinter; conveying of various kinds of hot and cold scrap or residuals; as well as conversions or retrofits of existing material handling equipment.

I Aumund Fördertechnik
Hall 4, stand F18



Conveyor belt for pellet cooling and transport (Picture: Aumund)

Surface inspection with enhanced system features

A proven partner in the metals industry for over three decades, Ametek Surface Vision continues to innovate its SmartView® surface inspection solution by developing new

features. The latest software includes a synchronized web viewer, which allows the user to open multiple viewers and use video file system enhancements, enabling more

efficient handling of large numbers of inspection files. Users of the modular software suite also benefit from the addition of an enhanced user interface, parts-per-mil-

lion data calculations and improvements to SmartView's thresholding and parallel classification capabilities.

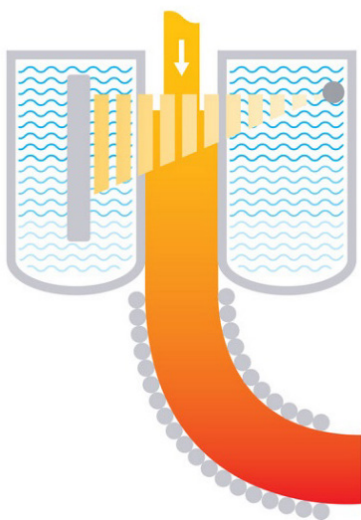
Highly-customizable to meet individual customer process needs, Smart-

View's reliable, real-time optical inspection of both sides of the metal product provides full visibility of surface quality, even in the most-demanding metal processing environments, helping to

increase product yields while lowering costs.

Ametek Surface Vision
Hall 4, stand F27/F29

Accurate and repeatable measurements in steel production



Graphic representation of the radiometric mould level measurement principle
(Picture: Berthold)

Measurement systems from Berthold Technologies are used to monitor critical processes and to improve efficiency in steel production. Berthold Technologies offers high-sensitivity detectors, thus allowing for highly accurate and repeatable measurements using source activities which are several factors smaller than conventional systems. Depending on the application the source activity can be reduced by as much as 80% while the measurement performance remains unchanged. This is a major advantage especially when aged sources become less effective because the high-sensitivity detectors can still perform the measurement. In this way the source life can be increased, saving costs and improving the use of radioactive sources.

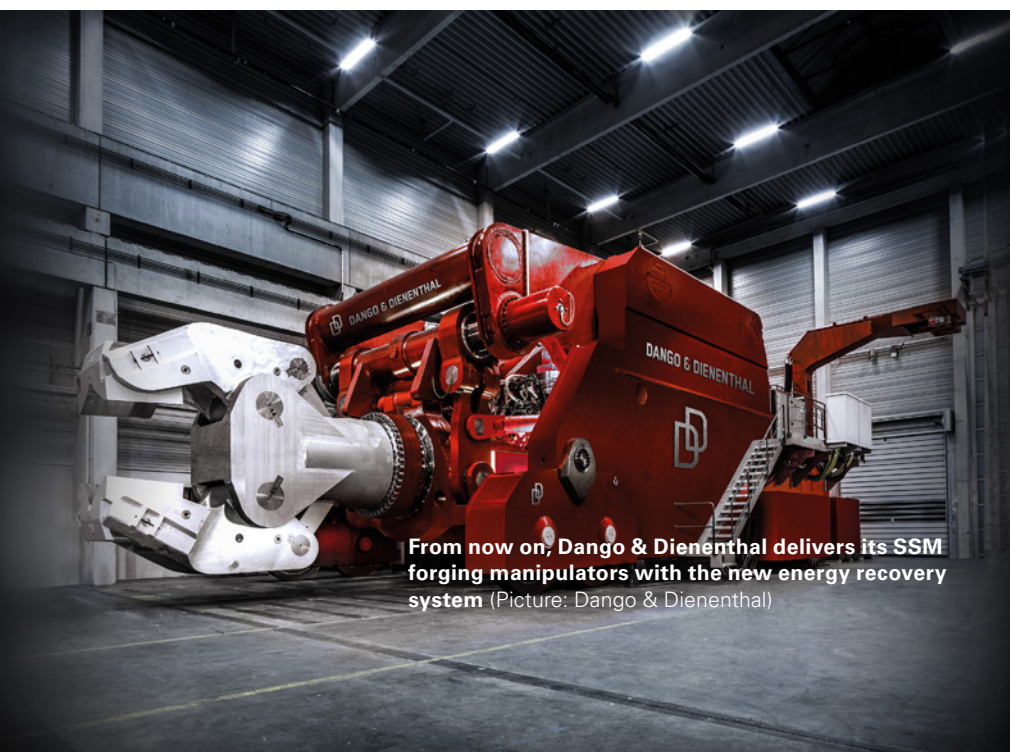
Berthold's measurement equipment and solutions are used for demanding loca-

tions in the steelmaking process, such as level measurement in continuous casting moulds. Precise and quick measurement of the mould level lays the foundation for the production of high-quality steel and the reliable prevention of steel overflows and breakouts.

Another challenging task is moisture measurement of coke and iron ore/concentrate in bunkers, silos, or conveyor belts. The moisture content in the coke and the iron ore/concentrate being fed to a blast furnace is of great importance for thermal control of the blast furnace process. Online moisture measurement at the bunker provides real-time information on the moisture content before the material enters the blast furnace.

Berthold Technologies
Hall 4, stand G30

Energy recovery system saves energy requirement of manipulators for open-die forging presses



From now on, Dango & Dienenthal delivers its SSM forging manipulators with the new energy recovery system (Picture: Dango & Dienenthal)

Dango & Dienenthal will for the first time be presenting rail-bound forging manipulators of its SSM series that come with the new ERS energy recovery system. By introducing the new energy recovery system, up to 70% of the energy input for the acceleration is recovered: During each deceleration action, the hydraulic fluid flows back into an accumulator from where it will be extracted for the next acceleration action. This reduces the manipulator's total energy demand by 25 to 30%.

During positioning of the forgings in the open-die press, the tongs of Dango & Dienenthal manipulators are carrying masses between 10 and 3,500 kN. In between the press strokes, the moving drive must accelerate and decelerate

masses – including the workpiece – of up to 14,000 kN. Dango & Dienenthal no longer uses proportional valves in the system but highly dynamic axial piston engines. These provide a number of advantages. As there is no loss due to throttling, the moving drive reaches its final speed earlier and will come to a halt faster. This results in considerably less time needed for the movements and less forging time per workpiece.

In the Dango & Dienenthal forging manipulators the tongs and the moving drive form one common unit. Thus the

ERS now adds the advantage of lower energy consumption to the benefits derived from simple and robust mechanical design. Additionally, the highly dynamic axial piston engines allow the manipulator to be controlled much more precisely and accurately than with the previously used proportional valves. Consequently, near-net-shape forging becomes more efficient, reducing subsequent finishing by machining or grinding.

Last but not least, replacing the proportional valves has dramatically reduced flow losses in the hydraulic system, and the

hydraulic fluid heats up less. Consequently, less energy is needed for fluid cooling. With a 25% lower installed power rating, the ERS achieves a significant increase in speed and a marked enhancement of operating precision. Also running operating costs are reduced because axial piston engines require much less maintenance than systems based on proportional valves.

Dango & Dienenthal
Hall 5, stand D07

Solutions for virtual casting and casting process optimization

Under the slogan "The digital casting process", Magma demonstrates how autonomous engineering is replacing conventional process simulation in continuous and ingot casting processes. The auton-

omous engineering software Magma-soft® and the program Magma CC for continuous casting optimization provide the basis for optimal process conditions for flow and solidification behaviour and

solutions for robust process windows. By making use of the fully integrated capabilities for virtual design of experiments and genetic optimization, both software programs easily and reliably find the best

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solutions for a new casting or process design, or production setup for steel, aluminium or copper applications. This

allows identifying the best compromise between the conflicting factors quality, productivity and cost.

Magma

Hall 4, stand E29 (METEC)

Hall 12, stand A19/20 (GIFA)

Laser-optical crossbow measurement for optimization of stretch-leveller performance



Crossbow measurement system at a continuous pickling line entry installed between the bridge roll and the process section (Picture: nokra)

At METEC, nokra will launch its new alpha.cb laser-optical system for the measurement of crossbow in strips in an inline process. The results from the inline measurements can be used to optimize stretch-leveller control so as to minimize crossbow formation. With processes becoming increasingly digitally interlinked, the measurement data can also be used to optimize up and downstream processes

– such as hot and cold rolling - by analyzing whether and where cooling strategies or coiling methods may promote crossbow formation. The system operates according to the light-section method, which uses laser lines projected onto the strip surface. The measuring frame, which accommodates the transmitter and receiver optics, is low enough to not interfere with the movements of the hall crane. At the same

time, the optical equipment is arranged at a safe distance from the strip surface, ruling out any risk of mechanical damage. The system requires no compressed air and no water cooling. It measures height at an accuracy of 0.1 mm. Together, the two cameras of the system capture approximately 3,200 pixels across the strip width. For a 1,800 mm wide strip, this means a transverse resolution of 0.6 mm.

For plate rolling mills, nokra will show laser-optical gauges for the combined inline measurement of flatness, thickness and contour. The sensor equipment for these measurements has been arranged within a very compact system. These gauges are used in plate mills at the hot rolling stands to monitor the rolling process, in downstream process stages, for example, at cold leveling machines, and for quality inspection of the finished plates.

Also on display at METEC will be nokra's alpha.ti 4.0 system, a laser-based, non-contact gauge for high-precision strip thickness measurements. The gauge operates at a measuring accuracy of 0.01% of the measuring range, i.e. over 15 mm the accuracy is $\pm 1.5 \mu\text{m}$. It features an automatic monitoring function that makes it MSA-compliant.

nokra Optische Prüftechnik und Automation

Hall 5, stand F20

Smart robotics increase safety in the continuous casting area

The continuous casting machine area is a work environment with risks. Interaction between human intelligence able to process hundreds of variables and smart robotics can increase safety by keeping the operator away from hot areas, and improve process quality and the traceability of semi-finished products. Polytec will

present a new series of robotics tools combined with machine vision, artificial intelligence and machine learning.

In continuous casting machines, a robotic cell may include a series of tools for opening the slide gate with the oxygen lance, manipulating the ladle shroud, taking temperatures and samples in the

tundish, distribute powder and artificial slag on the tundish. Thanks to 3D machine vision, this application can identify the nozzle position also in harsh condition, allowing the operator to supervise the process from a remote pulpit.

Another application allows the steelmaker to reuse and analyze the large



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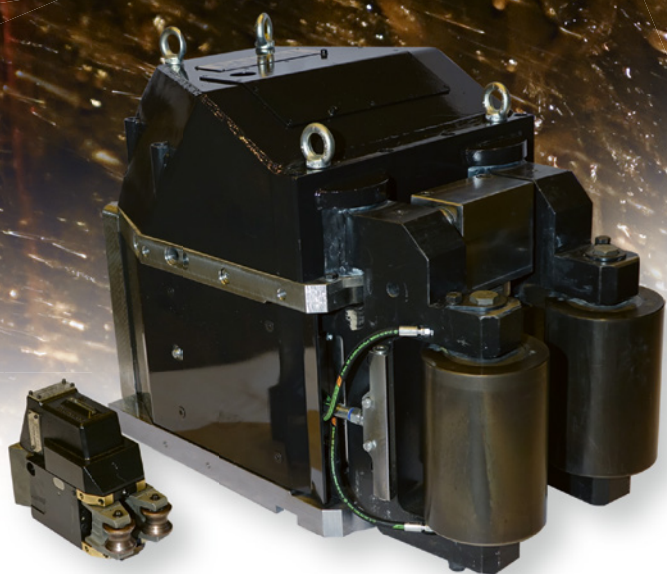
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Billet just tagged on the cooling bed with PolyTAG (Picture: Polytec)

quantity of process information already present in a casting machine. This application combines a powerful high-quality 3D machine vision system, a thermo-camera and new technologies for unsupervised machine learning. This

combination of advanced features allows the steelmaker to early identify out of spec production, improve the process and update the current practices and assumptions. The system is able to track more than 150 production varia-

bles of the casting machines (chemistry, alloys, temperatures, stirrers, speeds, water flows and pressure etc...).

A further application is a new technology able to improve the traceability of production and keep the operators safely away from the dangerous environment. By direct connection with the tracking system of the continuous casting machine, the robotics cell can store more than 5,000 consumables (precut tags and studs). The refill is online with no interruption to production. The smart robot is equipped with a machine vision system to identify the position and the distance of the billet and guide the welding tool to the right spot. The smart robotics cell is also able, as an option, to scan the billets in 3D and identify geometrical defects and autonomously double check the tag applied. The machine vision system reads the tag and stores the picture with the timestamp in the server as proof of production.

Polytec
Hall 5, stand G21

Product and service portfolio focused on digital plants, sustainable steel, productive assets and new business

Under the motto "Connect to Next", Primetals Technologies is displaying its comprehensive digitalization, technology, product and service portfolio for every step in the iron and steel production value

chain as well as the latest rolling solutions for nonferrous metals. Focus topics covered are digital plants, sustainable steel, productive assets and new business. Centerpiece of the booth architecture is the

"Steel City", offering an interactive experience of complex plant processes. The "Future Lab" gives deep insights into e-services and digital solutions. In the "Pioneers Lounge", presentations, panel discussions and other event formats are hosted. Primetals Technologies is also giving around 45 technical presentations at the ESTAD congress.

Providing answers to what the future holds for metals producers is the key for their business success. Primetals Technologies is supplying insights into the fascinating possibilities on the way to the fully automated steel plant of the future, laying out what is possible today and what will be state of the art in a few years. Technology experts and the management team will be there to answer questions about key technologies that can help metals pro-



3D rendering of Primetals Technologies' METEC area (Picture: Primetals Technologies)

ducers to take a decisive step toward fully digitalized operation.

Primetals Technologies offerings are centred around four focus topics. Digital plants: connectivity, quality optimization and digital twins are just three of the many new keywords that indicate how much digitalization is changing steel production. Sustainable steel: green production technologies are changing steel production for

a more environmentally friendly tomorrow. In order to achieve sustainable growth, it is crucial to use energy and raw-material resources as economically as possible. Productive assets: knowing in detail what goes on in a plant is a great advantage for any steel producer, as is making this information available to those who need it, when they need it. New business: this focus topic answers important questions

like how can an entrepreneur best break into the metals business, what steps should a veteran steel producer take to improve operations, make portfolio adjustments, and find the right market segments to maximize profitability.

Primetals Technologies
Hall 4; stand E02-E10

Storage and blending bed systems

Schade Lagertechnik offers storage and blending bed systems used in iron and steel production, in raw materials handling and in the handling of dry and fossil energy bearing materials.

Schade designs and supplies stockyards and blending beds of circular or longitudinal shape with stackers, tripper cars, bridge-type scraper reclaimers, por-

tal and semi-portal scraper reclaimers, cantilever scraper reclaimers, wagon unloading systems for handling coal, ore, limestone, fertilizer and many other bulk materials.

Schade Lagertechnik
Hall 4, stand F18



A semi-portal scraper reclaimer (Picture: Schade Lagertechnik)



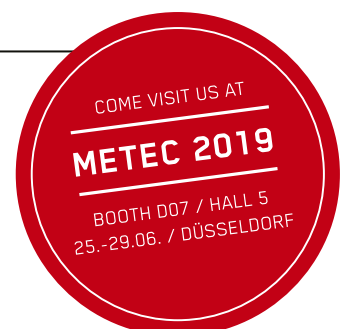
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Inline quality control of metal pipes, strips and plates

Sikora will be presenting a broad portfolio of innovative systems for non-destructive quality control and process optimization of steel tubes, strips and plates. For example, the Radar Scan 6000 system provides non-contact

inline measurement of the diameter and ovality of metal tubes and rods. The system is based on progressive, high-resolution radar technology and records measuring values over 360° of the circumference of the product to micron

accuracy. The measurement is carried out by radar transceivers simultaneously from several directions. It is insensitive to heat, dust and steam. Due to its slim design, the system can be easily integrated into the production process for hot or cold measurement. The technology measures regardless of the surface roughness in typical tube applications. The measuring values are clearly displayed graphically as well as numerically on the display of the processor system Ecocontrol 6000.

Another highlight at the Sikora booth is the Planowave 6000 M, a non-contact measuring system that is used for non-destructive thickness measurement of slabs, strips and plates independent of material, temperature and surface of the product. The measurement of the product is also based on radar technology. Transceivers above and below the material continuously send and receive frequency modulated millimeter waves. The thickness – typically centreline thickness – of the product is precisely determined from the runtime difference. The Planowave M system is designed for a typical measuring range of up to 500 mm. The system is used directly in the production line or at the end of the line for final quality control.

Furthermore, Sikora is presenting the Laser Series 2000 for non-contact and non-destructive measurement of the diameter and ovality of metal tubes, wire rods and bars during production. The measuring method is based on the use of laser light sources and CCD sensors in combination with powerful signal processors. The outer diameter of the metal tube is calculated by means of an intelligent diffraction analysis.

Sikora also showcases systems for quality control of metal tubes on the basis of X-ray technology: diameter and wall thickness measurement for metal tubes made of aluminum and certain light metal alloys, or reliable measurement of the plastic coating on steel tubes.



The Radar Scan 6000 is based on radar technology and delivers precise diameter measuring values independent of environmental conditions, such as heat, dust and steam (Picture: Sikora)

Sikora
Hall 3, stand A58

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METEC



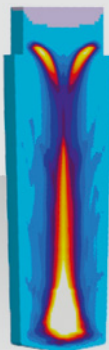
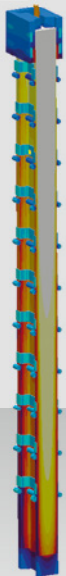
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Hall 4 / Stand E29

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Experiencing digitalization and future-oriented technology for all stages of the steel and NF-metals value chain

At SMS group's Metec booth visitors will get first-hand information about the entire technology and service portfolio offered by SMS group. With its holistic approach to digitalization and process control along all stages of the supply chain – as in the learning steel mill – SMS group builds not only highly efficient new production facilities, but it also upgrades existing ones to a state that compares with that of brand new plants. Among others, SMS group will present its activities in the field of additive manufacturing. SMS already uses additively manufactured components in its plants and has been strongly promoting the development of highly specialized metal powders. The company uses its powder atomization plant in Mönchengladbach, Germany, not only for the production of high-purity metal powders for additive manufacturing applications, but also develops new design and manufacturing methods there.

SMS group will also be presenting innovations under the umbrella topic "New Horizon". In more than 150 years as a player in the metallurgical plant engineering sector, SMS group has accumulated a

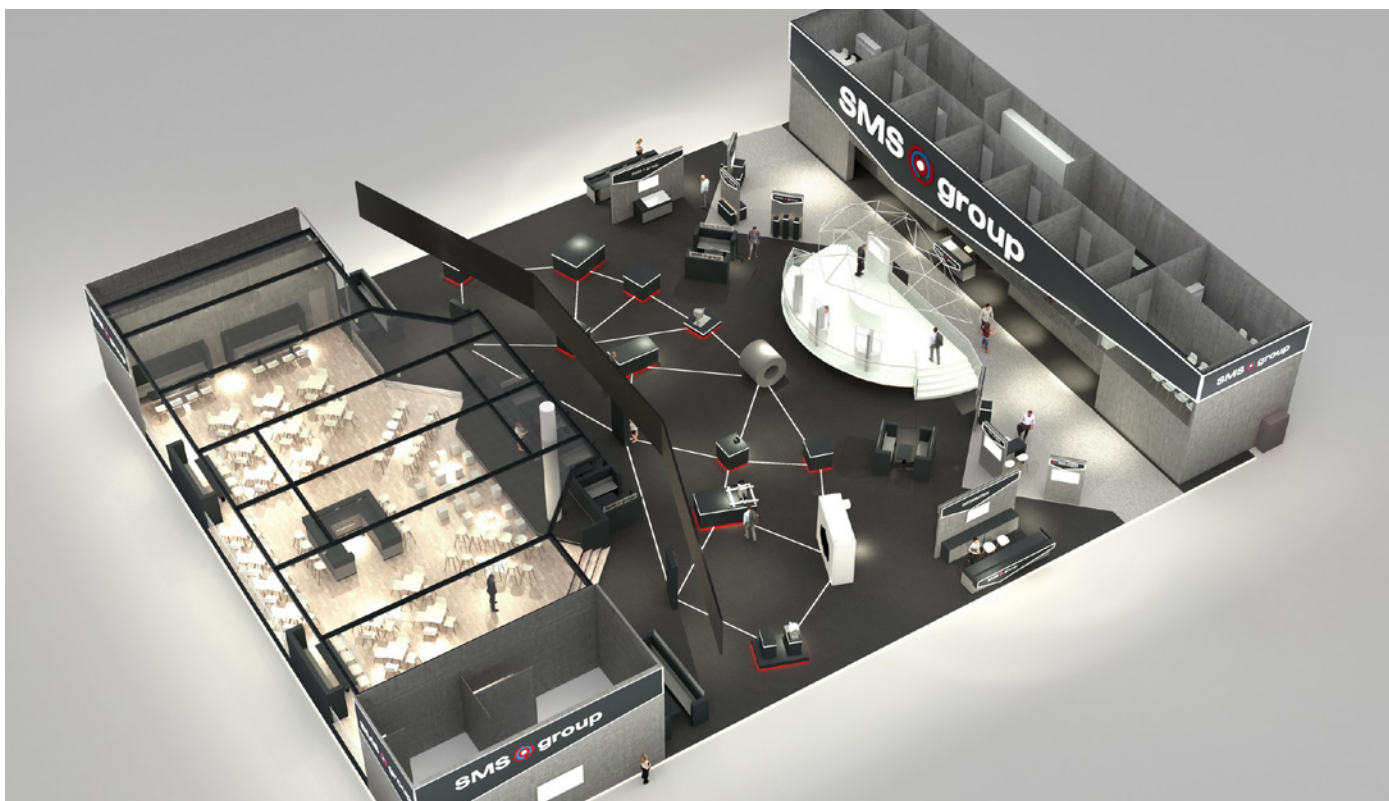
wealth of expertise based on which it has started to address urgent and future-oriented topics in a concerted approach by offering technologies for the complete life cycle of metals. For example, technologies that extract and process metals in an economically efficient and, at the same time, eco-friendly way, and allow them to be recycled virtually endlessly back into the raw material cycle. Against the backdrop of constantly decreasing resources of metals that are crucial for the application of new technologies – such as nickel, cobalt, aluminium oxide, titanium, vanadium, lithium or rare earths – SMS group has developed new, profitable processes for the extraction of metals from secondary sources and sources that could only be exploited with limited efficiency in the past.

Besides that, SMS group designs resource-saving, integrated plant solutions for primary and secondary process routes in non-ferrous metals production within the joint venture PolyMet Solutions. The Luxembourg SMS group company Paul Wurth develops new CO₂-free steelmaking techniques that make for a

significantly smaller CO₂ footprint of the steel industry. Cooperating with Sunfire, a company based in Dresden, Germany, Paul Wurth is taking a direct reduction process to market maturity, in which the fossil element carbon is substituted with hydrogen, and from which no climate-damaging CO₂ arises, only water vapour. In this context, Paul Wurth also engages in the research of systems for the production of green hydrogen, which is produced exclusively with renewable energy. In a cooperation with UrbanGold GmbH from Austria, SMS group has developed an economically efficient process able to recover and feed back into the raw material cycle high-grade, valuable materials previously considered as lost materials from electric and electronic scrap.

At ESTAD 2019, SMS group experts will be presenting new developments and successful reference projects in more than 60 technical papers.

SMS group
Hall 5, stand E22



Model (topview) of the SMS group's area at METEC (Picture: SMS group)



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Greener and more efficient metals production through sustainable technology and Industry 4.0

Tenova's booth at Metec intends to be a window onto a green and more efficient way of producing metals. A unique opportunity for a comprehensive insight into the newest and most advanced metal making technologies.

Topics such as fossil-free steel production through hydrogen, large-scale metal powder production for additive manufacturing, and optimization of the process through digital technology will be presented under the motto "The smart way to metals". This approach is underpinned by a consistent strategy aimed at changing the business model along the entire value chain.

Among the solutions presented at the trade fair will be the Pomini Digital Texturing™ (PDT™) machine, which can be discovered through augmented reality, and

the Self Regenerative Burner (TRGS), a smart burner able to optimize the combustion process through the application of digital technology. At the "Tenova Arena", core technologies and cutting-edge solutions – including predictive maintenance, remote assistance and artificial intelligence – will be presented by Tenova experts.

The Tenova booth will also be a point of interest of ecoMetalsTrails, an initiative launched by Messe Düsseldorf with the aim to promote sustainability and support exhibiting companies that make a contribution to the environment and present their long-term commitment at the fair. Tenova will present a technology aimed at replacing carbon partially or totally with hydrogen as reducing agent of the direct reduction process. This is already applied

to two key projects: SALCOS® (Salzgitter Low CO₂ Steelmaking) and HYBRIT®, an initiative for fossil-free steelmaking established by Hybrit Development AB, a Swedish joint venture between SSAB, LKAB and Vattenfall. Also the latest generation of the TCF® twin-chamber melting furnace will be presented.

Tenova LOI Thermprocess offers process technology for efficient use of the energy content of the pyrolysis gas which results from contaminants adhering to the scrap.

Tenova will also take part with several papers in the accompanying ESTAD conference.

Tenova
Hall 4; stand A21



"The smart way to metals" is the motto under which Tenova presents its approach to future-oriented metals production (Picture: Tenova)

Mini-format de-bricking machine with rotary boom

TML Technik will be showing its new Unidachs 110 de-bricking machine, which is smaller and more compactly built than its predecessor the Unidachs 220, and it features the unique 360° boom rotation. The new machine has been designed for hot applications in the metallurgical industry, such as de-bricking of smaller ladles, Blast furnace runners, tundishes and furnaces. The 360° rotary cantilever boom can utilize attachments such as hydraulic hammers, rotary drum cutters or a bucket and can reach every point from which material needs to be removed.

The new Unidachs 110 stands out of the crowd with its compact design, high manoeuvrability and a strong hydraulic drive. The width of the undercarriage is only 1,315 mm and the height is 1,635 mm. This allows access to working areas that are not easily accessible for other machines. Due to the remote operation, the operator is always at a safe distance.

Compared with mini-excavators with an articulated arm it has a further degree of motion. The 360° boom rotation, combined with the double articulated cantile-

ver boom offers a very high level of flexibility: The attachments can be utilised at almost any required angle of surface to be worked on.

Despite the compact size of the machine, it has a large working reach, depending on the attachment, in combination with the kinematics of the boom a working radius of up to 5,000 mm can be achieved. With remote control operation, the operator is always working at a safe distance. The remote control system consists of a lightweight control panel with logically arranged elements, which can either be carried on a body belt or incorporated into a control station. If the machine is not visible from the control station, cameras can be installed on the machine as an option, to ensure visual contact with the machine and its environment, displayed on a split screen monitor. The machines are available with a choice of diesel-hydraulic or electro-hydraulic drives.

■ TML Technik
Hall 5, stand D22

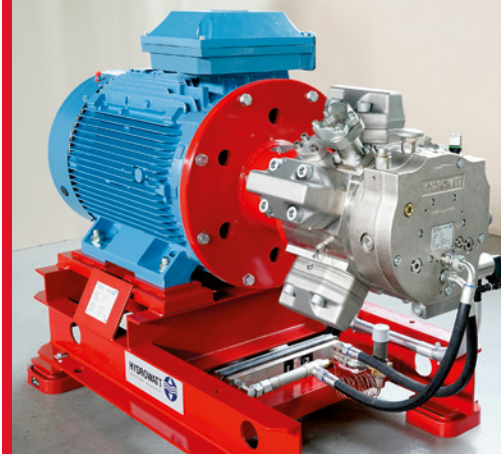


De-bricking of a blast furnace runner with Unidachs 100 (Picture: TML Technik)



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New laser gauge for highly dynamic thickness control during foil rolling

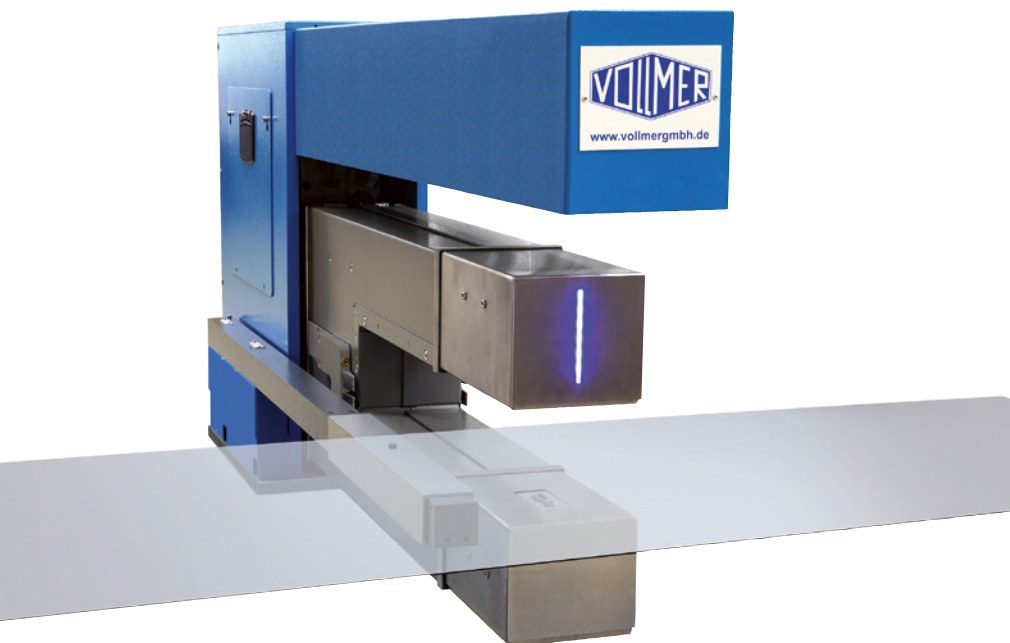
At METEC, Vollmer is for the first time presenting its new VTLG 101/1 laser-optical thickness gauge. This has been specially designed and developed for the cold-rolling of foils with a thickness between 0.003 and 2.0 mm. While previous systems of the VTLG series were

employed for strip of thicknesses between 0.015 and 12 mm, the new system has been developed for the rolling of foils. With a resolution of 0.05 μm , it now achieves an absolute measurement precision of $\pm 0.5 \mu\text{m}$ even when installed in the rolling mill. As with the other mem-

bers of the VTLG family, the VTLG 101/1 is also suitable for the rolling of flat products of steel and non-ferrous metals with matt or glossy surfaces. Vollmer has developed the VTLG not only for measurement in the rolling mill – it is equally suitable for use on the annealing line, in the finishing shop, on strip millers or in shear lines.

The VTLG thickness measurement systems are so compact and robust that they can be installed in the mill in the immediate vicinity of the roll gap. They operate with an internal scanning rate of up to 80 kHz. This makes them suitable for highly dynamic thickness control during rolling. Air cleaning systems ensure reliable operation even under the rough environmental conditions in the mill: Both the entry and exit windows of the transmitting and receiving lenses and the beam path are constantly flushed with clean air so that vapours or mists from the mill do not affect the measurement.

At METEC, Vollmer will also be presenting the classic contact gauges with digital measuring sensors and VTS evaluation that have superseded the amplifiers of the VMF series.



The systems of the VTLG series measure the thickness of flat products contact-free, from a safe distance and irrespective of the alloy (Picture: Vollmer)

Friedrich Vollmer Feinmessgerätebau
Hall 4, stand D18

Measuring gauges for high-precision dimensional measurement of long products

Zumbach Electronic will present a large range of systems and solutions for precise measurement and monitoring of dimensions and shape/geometry of bar, pipe and profile, hot and cold. Among others, Zumbach will showcase the new Profilemaster® SPS 80 which is based on highly developed light section technology and offers remarkable measurement capabilities for steel wire rod, bars and rebars. Beside dimensional measurements, the new system is able to scan for surface defects and highlight any identified defects in a simultaneous process.

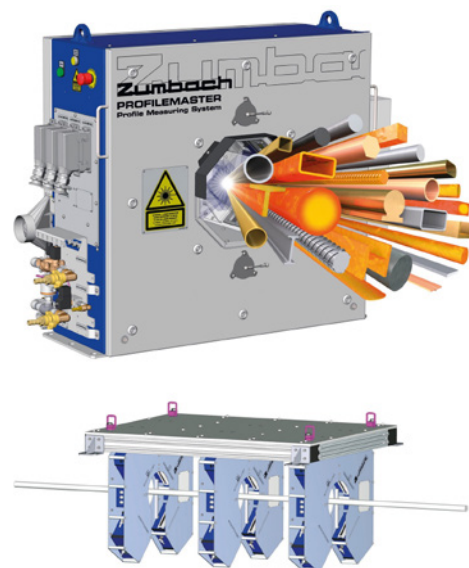
A fully rotating Steelmaster system with contact-free power and single transmission for a maintenance-free operation will also be on display as well as a brand

new Bendcheck system for the measurement and monitoring of straightness (bend) of bars and pipes.

For cold application such as centreless grinding, peeling, tube welding, drawing, rolling, straightening etc., Zumbach offers laser scanners and USYS processors for diameter measurement.

Zumbach Electronic
Hall 5, stand F22

A fully rotating Steelmaster system (above) will also be on display as well as a brand new Bendcheck system (below)
(Picture: Zumbach Electronic)



Hoisting equipment for reliable and safe handling

Hoists are indispensable equipment in foundry operations. At Gifa, Kito Europe will present manual hoists and electric chain hoists and examples of how they can be integrated into existing production facilities without much effort. Kito manufactures nickel-plated chains which feature higher corrosion resistance and less wear compared to conventional load chains.

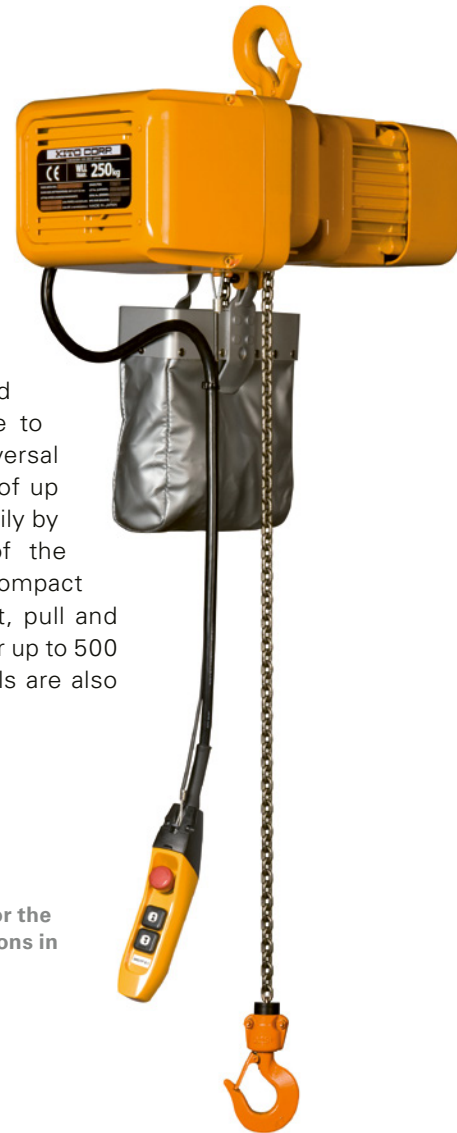
Electric chain hoists are available in different sizes, e.g. for assembly processes and precise positioning of the final fittings, as additions to cranes, for stationary or mobile usage. All Kito electric chain hoists are easy to control and produce only a very low load swing. Absolute load control and precise placement of the load are guaranteed.

Safety tested and certified by the Association of German Statutory Accident Insurers (DGUV), the Kito CB hand chain block is able to manage the toughest applications. Its little brother Kito CX mini is available in two variants with a load capacity of 250 kg or 500 kg. Overload protection (with slip clutch) is standard.

Lever hoists are mainly used where filigree parts have to be assembled in very confined spaces or at different working heights. Kito LB lever hoists withstand the most difficult challenges and are particularly suitable for heavy pulling, lifting and tensioning applications due to their robust design with universal freewheel function. Loads of up to 9,000 kg can be lifted easily by guaranteeing full safety of the operator. The lighter, more compact Kito LX lever hoists can lift, pull and position loads up to 250 kg or up to 500 kg. These lever hoist models are also DGUV safety tested.

Kito Europe
Hall 15, stand C08 (GIFA)

Electric chain hoist designed for the adverse environmental conditions in foundries (Picture: Kito)



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Interview

Digital Eco Systems in the metallurgical value chain

SMS group has made digital transformation a central pillar of its business strategy and has been consistently implementing the change that this entails in its product and service portfolio and in its corporate structure and culture. STEEL + TECHNOLOGY was given the opportunity to take a backstage look at a digital company of a very special set-up. As a subsidiary of SMS group, SMS digital GmbH develops innovative products and services which it uses to “digitalize” the metals industry. We talked with the two managing directors of SMS digital Bernhard Steenken and Dr. Markus Reifferscheid. The latter is also Vice President Research & Development at SMS group.

Does SMS group have a digitalization strategy?

Markus Reifferscheid: A strategy – in the sense of “Strategy is an economy of force” freely adapted from Carl Philipp von Clausewitz – is a must for a company of our size because by defining a vision and a mission we define and make transparent how we go about digitalization. We look at digitalization from two perspectives. On the one hand, we take an inward look. That is, we consider how we can make best use of digital methods to make our internal processes - from procurement down to the commissioning of our products – more efficient. At the same time, we look at our

customers’ processes and ask ourselves how we can create added value for our customers by offering tailored digital services.

One thing holds true for both: Digitalization cannot be bought, you have to design it yourself. We set great store by being seen

When we founded SMS digital GmbH a few years ago, we were convinced that it would be easier to respond to the dramatic growth in the demand for digital solutions outside classical corporate structures.

Markus Reifferscheid, Managing Director, SMS digital GmbH

not only as a provider of digital solutions, but rather as an innovative partner who advises his customers and accompanies them along their digitalization path. Using future-oriented technologies, we develop – very closely with our customers – tailored solutions that create sustainable value for them.

The Learning Steel Mill is our vision of a smartly networked production complex with the objective to optimize the entire value chain of the customers’ operations. This we achieve by combining engineering, automation and process knowhow with physical process models and data-based models generated by advanced AI algorithms. In a nutshell: We create value from data.

Obviously, the Learning Steel Mill is a core element of your approach to digital transformation. What does this exactly mean?

Markus Reifferscheid: Our concept of the Learning Steel Mill is that - by integrating all human operators and systems within an interacting network – all processes will continuously optimize and control themselves with a view to key performance



Dr. Markus Reifferscheid (left) is Managing Director of SMS digital and Vice President Research & Development at SMS group; Bernhard Steenken (right) is Managing Director of SMS digital (Picture: SMS group)

We already count more than 2,000 users of the digital applications provided on our my.sms-group platform
(Picture: SMS group)



indicators such as product quality, on schedule delivery and output. The Learning Steel Mill uses intelligent pattern recognition algorithms to evaluate what would be suitable scenarios. In other words, it permanently trains these learning algorithms, monitors itself on a continuous basis and feeds back conclusions from real incidents.

In order to achieve an optimal result along the entire production chain, all processes – from incoming material supplies via production down to distribution – have to be mapped in models and full data mastery is required of all relevant machinery, process and product data.

Has this vision of the Learning Steel Mill already been implemented at any of your customers' facilities?

Markus Reifferscheid: Currently, we can refer to two outstanding examples of successful implementation of our Learning Steel Mill concept: Big River Steel in the USA and Shandong Iron & Steel Group in China. Both companies serve as examples of how solutions from SMS group can digitalize the complete value chain from the

liquid steel to the finished product. These are strategically important lighthouse projects for us, which we take much pride in. These partnerships allow us to further advance ourselves and our products and services in order to pursue and bring forward the digital transformation of our customers' operations.

How can customers tackle the issue of digitalization? Where should they start?

Markus Reifferscheid: There is no general answer to this question. Only a specific analysis can provide a viable answer. Digitalization is all about immediate value creating. Therefore, the first step is to identify where existing processes – from material procurement down to material management, use of resources, such as materials, energy or personnel, etc. – or the capital lockup are not optimal and how digital techniques could make these processes more efficient, that means how can they be made faster and less costly. One starting point for identifying and quantifying such potentials is a systematic data analysis of realistic value stories using statistical or advanced AI methods. As soon as a prob-

lem has been mapped with sufficient detail with data and the value gain for the specific application has been determined, can the implementation start. In an agile methodological approach – such as Design Thinking – interdisciplinary teams of customer and SMS experts work out improvements with the objective to bring about a prototype for the first application – the Minimum Viable Product – after a maximum period of three months. During the subsequent trial phase, it is validated whether the determined value gain can be reached. When the value target has been reached or the additionally necessary effort to get closer to the set target has been determined to be too high, the team will stop at this point and tackle a new task. Otherwise, the innovation cycle of three months will be repeated until the desired result has been reached. Not only this approach, but probably also our innovative business and payment models may be new to our customers. Already today we offer numerous of our services as Software as a Service (SaaS) or Value as a Service (VaaS). Thus what used to be typical CapEx is now accounted as OpEx and payment is made partly or entirely on a pro rata basis and/or based on the actually achieved improve-



Successful implementations of our Learning Steel Mill concept are particularly visible at two locations: Big River Steel in the USA and Shandong Iron & Steel Group in China (Picture: SMS group)

ments. This model has become very well received by the market.

How do SaaS or VaaS work from the perspective of the user?

Bernhard Steenken: Both SaaS and VaaS use cloud computing. The software and the IT infrastructure are operated by an external service provider and used by the customer as a service. In concrete terms this means that the customers transfer data via an encrypted channel into a data room exclusively reserved to the customer and usable only for the previously defined purpose. All data in the cloud remains the customer's property and is hosted in computing centers/centres of highest security levels. The SaaS or VaaS provider is paid for the data analysis performed and the feedback of information usable for a value gain or for the service provided. SMS digital operates mySMS-group, a successful Industrial Internet of Things platform for the steel and NF metals industries. Customers can log in on this IIOT platform via reliable apps and immediately use the platform services. Implementing SaaS or VaaS solutions is easy, does not take much time and involves only moderate costs. Our

team has been observing a constant rise in the demand for these service models.

What does SMS digital stand for?

Bernhard Steenken: SMS digital stands for the core elements of our digitalization strategy: SMS digital is the name of our rapidly growing digital business and the name under which we combine all digital products and services offered by SMS group for the entire process chain. And, last but not least, the software company SMS digital GmbH bundles all SMS group digital competences worldwide. For the customer this provides the convenience of a one-stop shop. Here he finds operative expertise for any digitalization project, data analytics and data development competence and, via our my.sms-group platform, the portfolio of digital products and apps I have just described.

You already have a Business Area Digital within your group structure. Why are you promoting the growth of the subsidiary SMS digital GmbH?

Markus Reifferscheid: The answer is easy. When we founded SMS digital GmbH a few years ago, we were convinced

that it would be easier to respond to the dramatic growth in the demand for digital solutions outside classical corporate structures. This decision has definitely paid off because it has allowed the young team of SMS digital to develop digital products of their own without constraints while being actively involved in dozens of customer projects handled by SMS group. This strategy is still valid today. As software specialists, SMS digital GmbH relies on top talent from competence areas outside the traditional mechanical and plant engineering field. These people prefer working with agile methods in a start-up-like environment. The exchange between the two entities has never been as intensive as today. Bringing together digital, process, service and automation experts has proved ideal to make optimal use of development synergies. With SMS digital GmbH, we are in a position to offer a wide range of consulting services, merging our steel, process and production expertise with state-of-the-art digital knowledge.

What has SMS digital already achieved?

Bernhard Steenken: We already count more than 2,000 users of the digital applications provided on our my.sms-group platform. And SMS digital has already reached more than 100 customers in 50 countries and has meanwhile entered into more than 30 partnerships with companies. This proves that we are on the right track.

This sounds as if you are expecting rapid growth. Is your team set to take the challenge?

Bernhard Steenken: Absolutely. Until the end of this year, we will hire a considerable number of people to expand our team. The SMS digital team is a blend of experienced SMS specialists with product, process, automation and project management knowhow, and young and experienced newly recruited people who bring expert knowledge in the fields of software development, digital platforms and AI methods. They all share their enthusiasm for the digital world and their commitment to make the digital transformation at SMS group a success story. SMS digital has more than 60 employees, most of them are located in Germany and

the USA. By the end of the year, the number of employees will have grown to more than 100. We are very happy that we have been able to recruit this great number of specialists in the highly contested labor market.

Are working methods changing as a result? How do you work at SMS digital?

Bernhard Steenken: At SMS digital, we work very closely with our customers. Our interdisciplinary teams of experts are individually set up to best cater to the needs of a project. The team members adopt an agile problem-solving approach, developing user-oriented software solution in close cooperation with the customer at the customer's site. The customer is involved from the very beginning. He can give us feedback during any phase of the development. This guarantees that we understand and are able to implement exactly what the customer wants. And by giving his input, the customer becomes an agile player in the process of finding the best suited methodology for the aimed at result. To ensure that this process always works in the best possible way, we also make use of what we call "agile coaches". This saves us the hassle of travelling long distances and time-consuming discussions within the team and with the customers.

And how are you furthering digitalization within your own company? I mean for your internal projects.

Markus Reifferscheid: We see ourselves as a Learning Entity, in which process-related decisions should be backed by data-based models or by using digital methods and tools because this makes decision-making more efficient. A key aspect is that all relevant information be transparent and accessible in real time for all stakeholders. All our business areas and our global network constantly work to harmonize processes and integrate them seamlessly. This is the basis of all our digitalization initiatives. Thus a pro-active approach to business control will soon no longer be the exception but routine. All this requires direct access to all relevant information, both internally – for example, information from logistics, production, sales or procurement – and externally – from the material suppliers, logistics providers or third-party engineering service providers. In order to further advance digitalization within our corporate structure, we need a future-safe infrastructure capable of processing millions of data from all kinds of data systems. At the same time, the specific interests and requirements of the various departments and group areas have to be considered. A colossal challenge, but one we are well prepared to tackle.

Would you venture a look ahead for us? How far, do you think, will you still have to go?

Markus Reifferscheid: SMS stands for "Leading Partner in the World of Metals" and for almost 150 years during which our products, services and innovations have made our customers successful players in their respective markets. Against this backdrop, we endeavor to further strengthen our market leadership by offering our customers highest technological standards at economically attractive prices.

Bernhard Steenken: And for this, data is the main key to success. Alone the concept of the Learning Steel Mill shows how challenging our mission is and that it cannot be expressed by metrics. Therefore also the way lying ahead of us cannot be measured in percentage. But this is what makes this task so exciting – for everyone alike, the software and automation specialist, the mechanical and plant engineer and the service provider!

Thank you very much for this interview.

The interview was conducted by Arnt Hannewald.

G|S|B

Group

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- Silica Bricks
- High Alumina, AMC, ASC Bricks
- MgO, MgO-C & MgO-Chrome Bricks
- Spinel Bricks
- Precast Shapes
- Monolithic Lances
- RH Degasser Refractories
- Isostatic Products
- Complete Ladle Solutions



The image shows Martina Merz and Guido Kerkhoff standing in front of a large blue backdrop with the Thyssenkrupp logo. Martina Merz is on the left, wearing a purple jacket, and Guido Kerkhoff is on the right, wearing a dark suit and tie. The Thyssenkrupp logo is prominently displayed in white on the blue background.

thyssenkrupp

Martina Merz, Chairwoman of the Supervisory Board, and Guido Kerkhoff, CEO, at the Annual General Meeting 2019 of thyssenkrupp AG (Picture: thyssenkrupp)

European steel joint venture cancelled

thyssenkrupp to realign the group after the steel JV with Tata Steel stopped

The planned European steel joint venture – a merger of thyssenkrupp Steel and Tata Steel Europe – does not go ahead due to resistance from the European Commission. thyssenkrupp decided a strategic realignment of the group with IPO of elevator business instead of separation into two companies. Tata Steel, however, remains committed to its strategy to create a sustainable portfolio in Europe.

In early May, Competition Commissioner Margrethe Vestager informed thyssenkrupp and Tata that despite extensive concessions made by both, thyssenkrupp and Tata Steel the European Commission will not approve the joint venture under the current conditions.

The European Commission took the improvements of the submitted covenants proposed by thyssenkrupp and Tata Steel as an opportunity to conduct another market test. The new market survey did not resolve the Commission's concerns, although the partners had offered significant further concessions.

From the point of the view of thyssenkrupp and Tata Steel, further commitments or improvements would adversely affect the intended synergies of the merger to such an extent that the economic logic of the joint venture would no longer be valid.

Consequently, the partners assume that the European Commission will not approve the joint venture.

thyssenkrupp to fundamentally realign itself – IPO of elevator business

With the expected unsuccessful outcome of the steel joint venture, the Executive Board of thyssenkrupp AG has reassessed the strategic options for the company and will propose to the Supervisory Board to not go ahead with the planned separation into two independent companies.

The economic downturn and its effects on business development and the current capital market environment have led to the separation not being able to be realized as planned.

Instead, thyssenkrupp will fundamentally realign itself to significantly improve its operating performance. This will include a value based more flexible portfolio approach with greater freedom for the development of all businesses. At the same time, the company will sustainably

strengthen its capital base in order to gain the necessary financial leeway for necessary restructuring and business development.

The elevator business is to be listed on the stock exchange via an Initial Public Offering (IPO). The existing Group and administrative structures will become significantly leaner and the performance of the individual businesses will be improved. The plans also include a Group-wide performance program involving the reduction of 6,000 jobs.

The Supervisory Board of thyssenkrupp AG unanimously approved the Executive Board's plans for a fundamental realignment of the company. Guido Kerkhoff, Chief Executive Officer of thyssenkrupp AG: "With the approval of the Supervisory Board, we can now tackle the strategic realignment. The new strategy focuses on the economic success of our businesses. With the IPO of the elevator business, we are strengthening our capital base so that

we can press ahead with the further development of the individual companies within the Group. At the same time, we will manage our businesses as a flexible portfolio and consistently align our new organizational structure with it. Together with co-determination in the steel business, we will quickly begin talks on how to make steel sustainably successful."

Tata Steel to pursue the end state strategy for the European business

While the proposed joint venture was an important strategic initiative for Tata Steel to create a sustainable portfolio in Europe that would have also helped to de-consolidate the European Business and de-leverage its Balance Sheet, Tata Steel remains committed to the above strategy and would explore all options to achieve similar outcomes in the future. Currently, around two third of the business of Tata Steel is India based with best in class competitiveness and a focused growth strategy. With the commissioning of the 5 million tons per annum Phase 2 of the Kalinganagar works in the next 30 months with value added product mix, Tata Steel's share of business along with its profitability will increase further. The India business therefore is well positioned to continue to enhance its earnings and cash flow performance levels from that achieved in 2018-19 with extensive market reach, strong brands, differentiated products, enhanced asset base post Kalinganagar expansion and a strong talent pipeline. While pursuing the end state strategy for the European business in the near term, Tata Steel will also continue to focus on its performance management to enhance its earnings and cash flows to build a sustainable and self-sustaining future for the business. Tata Steel has also undertaken significant de-leveraging in the last 6 months and would continue to pursue the same through internal cash generation and asset sales.

Background

Tata Steel and thyssenkrupp had signed definitive agreements on June 30, 2018 combining the steel businesses in Europe to create a 50:50 pan European joint venture company focusing on customer centricity, technology and sustainability.

"If fundamental parameters change, we owe it to our employees, customers and shareholders to reassess the situation. And above all, to do the right thing."

Guido Kerkhoff, CEO of thyssenkrupp AG

Both parties have been in intense engagement with all regulatory authorities and in particular the European Commission to seek clearance. Based on the Statement of Objections published by the Commission, a comprehensive package of remedies was offered covering all the areas of concern highlighted by the European Commission. The remedies offered were developed considering the overall industrial strategy for the proposed joint venture, the integrated and complex nature of the supply chain to service customers and the need to build a sustainable business which would be able to endure the structural challenges faced by the European steel industry. However, the feedback from the European Commission based on the market test it has undertaken suggests that it is unlikely to clear

the proposal in spite of the significant remedies offered.

In the view of thyssenkrupp and Tata Steel, further commitments or improvements to the remedy package would adversely affect the basic foundation of the proposed joint venture and the intended synergies arising from the merger to such an extent that the economic logic of the joint venture would no longer be valid and it's the fundamental sustainability would be severely impacted. Hence both partners are unable to offer any further remedies to the Commission to meet its requirements. Consequently, the partners assume with deep disappointment that the European Commission will not approve the joint venture.

I thyssenkrupp; Tata Steel



HAC

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- Brown Fused Alumina
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ArcelorMittal holds investor event in Italy

Ilva Taranto to be transformed into ArcelorMittal Italy

ArcelorMittal, the world's leading steel and mining company, hosted an investor event at the ArcelorMittal Italia facility in Taranto (Italy) in March. The event focused on the strategic initiatives ArcelorMittal is undertaking to transform the site into a modern, best-in-class, integrated steel producer, capable of producing high-quality products, satisfying its natural customer base and re-establishing a trusted and transparent relationship with the local community and other key stakeholders.

At the investor event ArcelorMittal informed about plans and priorities to transform the plant into a high-performing, low cost, top-tier steelmaking asset, with a comprehensive product offering. Speakers included Aditya Mittal, Group President and CFO, and CEO of ArcelorMittal Europe, Geert Van Poelvoorde, CEO of ArcelorMittal Europe Flat Products, and Matthieu Jehl, CEO ArcelorMittal Italia. The presentations by members of the senior management, highlighted the progress made at ArcelorMittal Italia since ArcelorMittal assumed ownership of Ilva on 1 November 2018 and illustrated the strategies to improve in four key areas as following:

- health and safety,
- environment,
- industrial plan to turn around the plant,
- plans to fully integrate ArcelorMittal Italia into the ArcelorMittal Europe Flat Products business.

Buy, make, sell is ArcelorMittal Italia's key business philosophy and where € 310 million synergies will be captured. ArcelorMittal Italia will look to leverage ArcelorMittal's size and expertise in improving the efficiency of underperforming assets and ensuring business continuity in raw materials, maintenance and repair; and utilise Italy's position as Europe's second largest steel consuming market and ArcelorMittal Italia's role as a relevant local producer.

In terms of performance ArcelorMittal Italia is on track to reach a 6 million t annual run-rate in 2019, with crude steel production to increase to 8 million t per annum once the company's environmental investment programme has been completed. ArcelorMittal continues to expect ArcelorMittal Italia to be Ebitda positive in year one and to see free cash flow positive in year 3.

Within ArcelorMittal Italia's € 2.4 billion investment plan, € 1.15 billion are allocated to approx. 70 environmental pro-

jects, among these are four key elements as following:

- raw material yards: zero dust emissions in Tamburi from the raw materials yards and conveyor belt before the first half of 2020 (€ 350 million)
- rain and waste water treatment: elimination of run off polluted water (€ 160 million)
- filter in the sinter plants: dust, metals and dioxin reduction to lower levels than EU BAT (€ 35 million)
- coke plant revamping: installation of reach best-in-class technology (€ 200 million)

The other investments are allocated to comprehensive industrial investments.

ArcelorMittal's European flat products business highlighted its leadership position in the European flat market. Ongoing efforts shall drive further productivity gains; its ongoing investment programme; progress in improving product capabilities and developing its range of higher added value products.

The "Action 2020" programme across ArcelorMittal Europe Flat Products focuses on the transformation plan, digitalisation and cost efficiency, all of which shall enable the company to outperform the competition. The equally impactful next phase in the Transformation plan is driven by digitalisation, positioning the company to increase the performance gap compared to competitors. Investments being made in breakthrough technologies are tackling the carbon challenge and maintain industry leadership through innovation.

The integrated iron and steel works in Taranto, Italy is to become the lowest cost site in Europe with full complement of downstream capabilities (Picture: ArcelorMittal)



ArcelorMittal

Refractories

Dalmia Seven inaugurates first-of-its-kind monolithics production line in India

Dalmia Seven, a joint venture between Dalmia Bharat Group and Seven Refractories of Europe, has set up a monolithics production line to meet the growing demands of the steel industry in India. The new line has enhanced the plant's annual capacity to 45,000 t and can deliver up to 50 t per shift.

Dalmia Seven is a leading supplier of monolithics in India. In early May the company inaugurated a new Monolithics production line at its Katni, Madhya Pradesh manufacturing plant. The new production line is the 'first-of-its-kind' in India and equipped to manufacture a range of monolithic products. It incorporates best practices and unique equipment that allows for shorter and accurate production cycles ensuring that customers get the benefit of cutting edge refractory supplies and precision.

The new production line at the Katni manufacturing plant has enhanced the overall plant capacity to 45,000 t per annum and is poised to meet the growing demand of steel producers in domestic markets. It is equipped with state-of-the-art feeding and mixing circuit controlled by centralised processing software and can deliver up to 50 t per shift.

At the "Day 1," Sameer Nagpal, Chairman of Dalmia Seven commented that "India is now the second largest steel producer in the world. The new line has been set up to cater to the increasing demand of steel producers. Aligned with the Government's 'Make in India' mission, this facility will help us substitute the high end products which are still imported from Europe." Commenting on the association between Dalmia Bharat Group and Seven Refractories, Erik Zobec, Group CEO, Seven Refractories stated: "Our collaboration is growing steadily. Over two years of association, Dalmia Seven has consistently invested in technology and in building a world-class manufacturing setup to give customers an innovative and reliable refractories partner right at their doorstep." This expansion will help Dalmia Seven to deliver cutting-edge refractory products to customers in India while ensuring the highest standards of technology and quality.

The refractory business of Dalmia Bharat Group

Started in 1954, the refractory business of Dalmia Bharat Group today is represented by Dalmia-OCL and GSB Group. It offers end-to-end refractory products, solutions and services to customers in more than 40 countries in core manufacturing sectors such as iron & steel, cement, glass, non-ferrous metals and energy & petrochemicals. It is a leader and pioneer in several mission-critical refractory product cat-

egories including high-alumina bricks for cement manufacturing. Backed by 6,000+ man-years of International refractory experience, 7 manufacturing plants (5 in India, 1 in China, 1 in Germany), on-site servicing capabilities, consistent product performance and a dedicated refractory technology R&D centre, Dalmia-OCL is currently India's fastest-growing refractory business.

I Dalmia Seven



In early May the company inaugurated the new production line at its Katni manufacturing plant (Picture: Dalmia Seven)

World first for steel

ArcelorMittal investigates the industrial use of pure hydrogen for direct reduction

In order to permanently reduce CO₂ emissions, ArcelorMittal has developed a low-emissions technology strategy, which targets not only the use of alternative feedstocks and the conversion of CO₂ emissions, but also the direct avoidance of carbon (Carbon Direct Avoidance, or CDA).

This year, ArcelorMittal intends to launch a new project in the plant in Hamburg, Germany to use hydrogen on an industrial scale for the direct reduction of iron ore in the steel production process for the first time. A pilot plant is to be built in the coming years.

With a production volume of 8 million tonnes crude steel, ArcelorMittal is among the largest steel producers in Germany. The group runs four large production sites in the country. These are two fully integrated flat carbon sites in Bremen and Eisenhüttenstadt as well as two long carbon sites in Hamburg and Duisburg.

Already today, the Hamburg plant has one of the most efficient production processes of the ArcelorMittal group due to the use of natural gas in a direct reduction plant (DRI). The aim of the new hydrogen-based process is to be able to produce steel with the lowest CO₂ emissions. The

“The use of hydrogen as a reducing agent shall be tested in a new shaft furnace.”

Frank Schulz, CEO of ArcelorMittal Germany

project costs amount to around 65 million euros. In addition, a cooperation agreement with the University of Freiberg is planned in order to test the procedure in the coming years at the Hamburg plant premises. The hydrogen-based reduction of iron ore will initially take place on a demonstration scale with an annual production of 100,000 tonnes.

“Our Hamburg site offers optimum conditions for this innovative project: an electric arc furnace with DRI system and iron ore pellets stockyard as well as decades of know-how in this area. The use of hydrogen as a reducing agent shall now be tested in a new shaft furnace,” comments

Frank Schulz, CEO of ArcelorMittal Germany.

In the process, the separation of H₂ with a purity of more than 95 percent from the top gas of the existing plant should be achieved by so-called pressure swing adsorption. The process is first tested with grey hydrogen (generated at gas separation) to allow for economical operation. In the future, the plant should also be able to run on green hydrogen (generated from renewable sources) when it is available in sufficient quantities.

With the Hamburg hydrogen project, ArcelorMittal is advancing pioneering technology for direct CO₂ avoidance as one of a number of potential pathways for low-emissions steelmaking. The group is already investing more than 250 million euros in various carbon emissions reduction technologies, for example in Ghent where waste carbon gases will be used for the production of alternative fuels or in chemical products. Likewise, methods are tested in which biocoal from waste wood is used instead of coking coal as a reducing agent in the blast furnace.

ArcelorMittal is committed to climate protection. With its multi-technology approach, the group wants to make an active contribution to achieving the ambitious climate and energy policy goals of the Paris Agreement and to identify which technologies are technically and economically feasible to reduce, capture or avoid CO₂ emissions



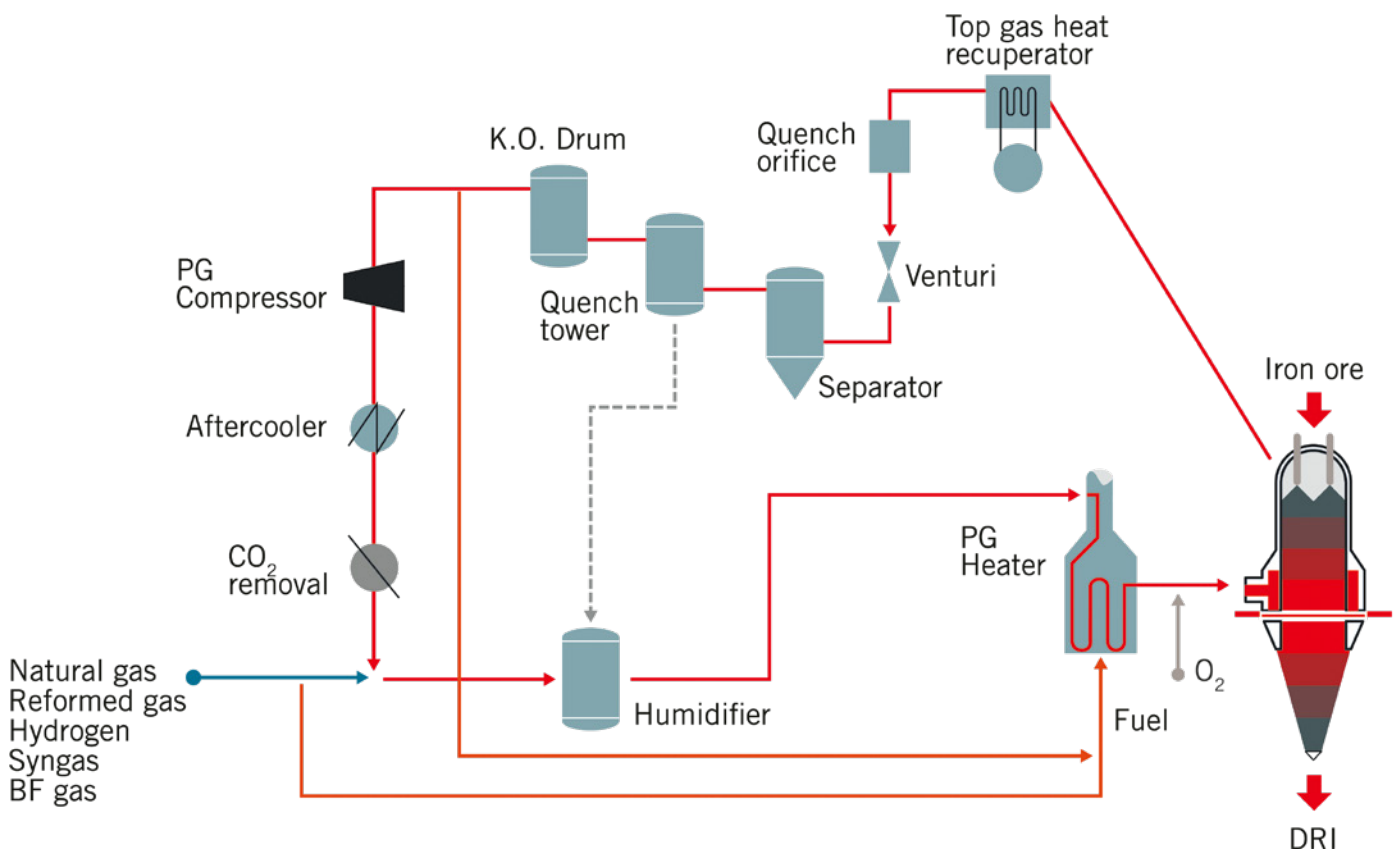
ArcelorMittal operates a DRI plant at the Hamburg site (Picture: ArcelorMittal)

| ArcelorMittal Germany

Ironmaking – Steelmaking

Sustainable decrease of CO₂ emissions by means of an innovative direct reduction technology

Compared to the traditional BF-BOF way of producing steel, more than 50% of CO₂ emissions can be saved when steel is produced by means of the Energiron Direct Reduction – Electric Arc Furnace route. Operating costs are competitive, provided that the reducing agent is available at reasonable price: the Energiron process can use either natural gas, syngas or BF off-gas, whichever is locally available at the cheapest price. Furthermore, even Hydrogen can be used as reducing gas, without any modification to the original Energiron process scheme.



Energiron ZR basic process scheme (Picture: Danieli)

Dario Pauluzzi, Danieli S.p.A. Buttrio, Italy; Stefano Maggiolino, Tenova HYL, San Nicholas, Mexico

Energy, mass and emissions balances for a BF-BOF and DR-EAF integrated mill [2]

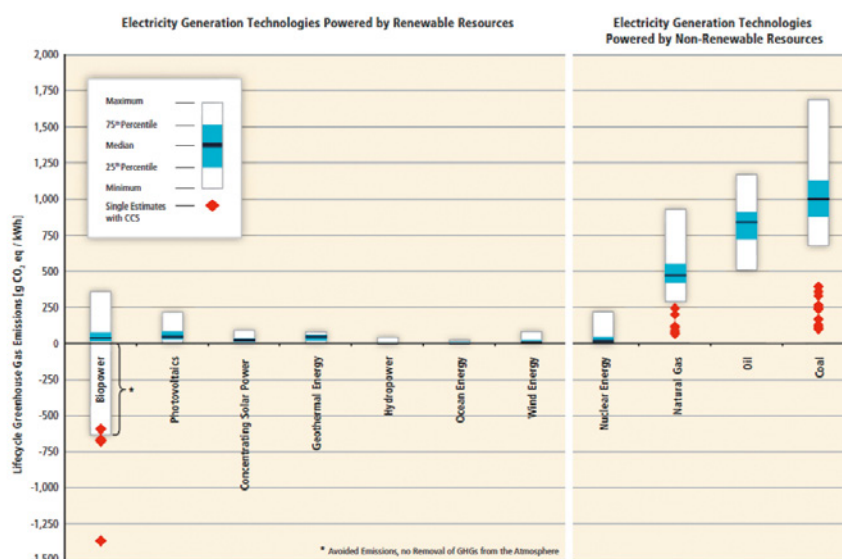
Typical BF-BOF steelworks			Typical DRP-EAF mill		
Input material	Consumption	CO ₂ emissions	Input material	Consumption	CO ₂ emissions
Coaking coal (dry)	430 kg/tls	1,293 kg CO ₂ /tls	Natural gas	2.22 Gcal/tls	526 kg CO ₂ /tls
Pulverized coal	150 kg/tls	434 kg CO ₂ /tls	Dolomite	32 kg/tls	15 kg CO ₂ /tls
Limestone to BF/sinter	120 kg/tls	53 kg CO ₂ /tls			
total: 1,780 kg CO₂/tls			total: 541 kg CO₂/tls		
Electric power credits	- 330 kWh/tls	- 165 kg CO ₂ /tls	Electric power incl. O ₂	630 kWh/tls	315 kg CO ₂ /tls
total: 1,615 kg CO₂/tls			total: 856 kg CO₂/tls		

Customers and markets are continuously pushing for technologies which allow having high quality steel produced in an economic and sustainable way. The Blast Furnace (BF) - Basic Oxygen Furnace (BOF) process, directly using iron ore as raw material for steel production, is certainly the preferred way for producing high grade steel. However, when coal is used as a reducing agent, a significant amount of carbon dioxide is emitted into the atmosphere. Contrary to this, environmental parameters are more easily respected when steel is recycled from scrap via electric arc furnaces (EAF). To produce the highest steel grades, EAFs have to be fed with a mixture of scrap and virgin iron units which dilute the tramp elements contained in steel scrap. Direct Reduced Iron (DRI) is used to accomplish this task.

Among all the available technologies, Tenova HYL and Danieli have jointly developed the Energiron direct reduction process which allows higher energy efficiency levels and lower gaseous emissions, especially in terms of CO₂, where reductions by up to 40-60% can be achieved.

Process scheme of the reformer

The Energiron Zero Reformer process allows carrying out the natural gas reforming stage within the reactor. No external reformer is required. Instead, the DRI itself is used as reforming catalyst. As compared to other processes for which the overall efficiency is below 70%, for this scheme the efficiency is above 78% and natural gas consumption is kept as low as 2.35 Gcal/t.



Process schemes of a BF-BOF iron and steel works, and a DR-EAF integrated mill [2] (Picture: Danieli)

CO₂ emissions of the BF-BOF and DRP-EAF routes

A study was performed comparing the CO₂ emissions generated by the two steelmaking routes BF-BOF and DRP-EAF. The equivalent CO₂ emissions for production of 1 kWh are considered according to the LCA (life-cycle assessment technique to assess environmental impacts) method [1]. For the purposes of the study case, it was assumed that the electrical energy is produced from the combustion of natural gas. This was made based on the assumption that the direct reduction plant is fed by natural gas.

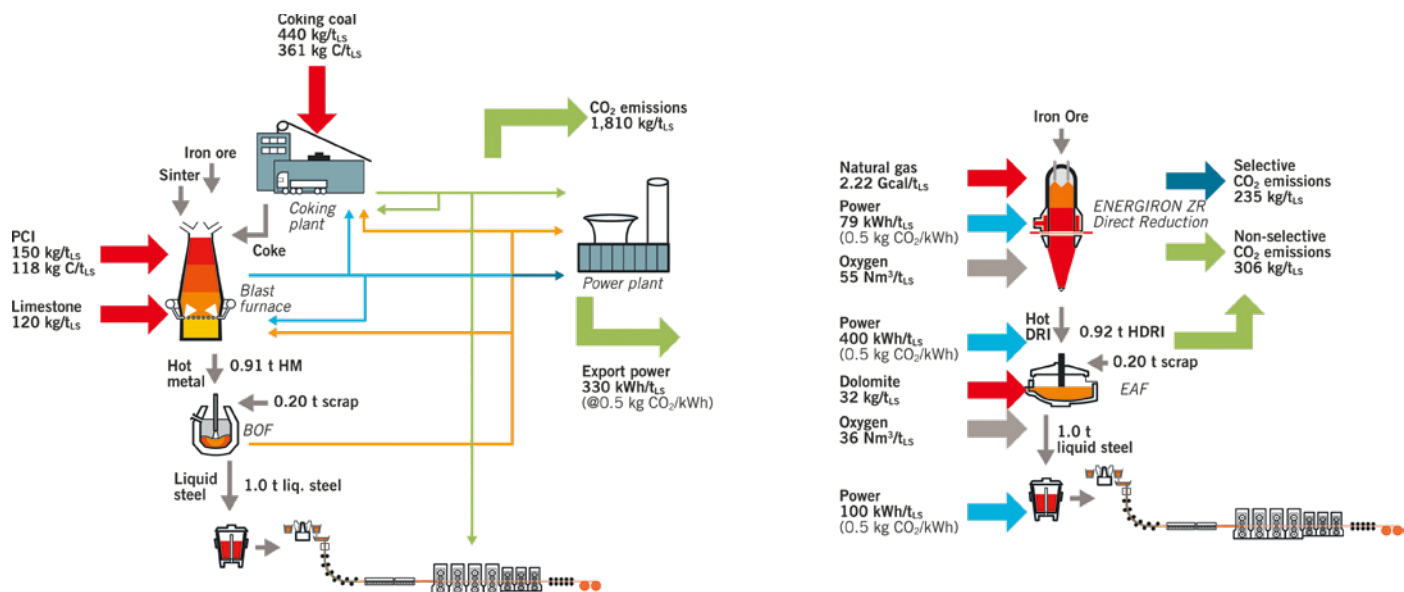
The direct reduction plant considered in this comparative analysis is based on the Energiron ZR process scheme and it

is assumed to produce high-C DRI (94% Mtz and 4%C), which provides additional energy for secondary reduction of FeO, as 80% feed to the EAF.

The comparative analysis shows that the carbon footprint of a BF-BOF mill is approximately double that of a modern DRP-EAF mill. Further improvements in emissions and energy efficiency can be achieved when the direct reduction plant is based on the Energiron ZR process.

Minimum energy demand, minimum emissions

Among all the direct reduction technologies, as of today the Energiron process is the one providing the highest efficiency. Since the reducing gases are generated inside the reactor, most of the energy sup-



Energiron ZR using hydrogen as reducing agent: process scheme and CO₂ emissions (Picture: Danieli)

Reduction of CO₂ emissions for the Energiron ZR DRP

CO ₂ emissions (per t of DRI produced)	Energiron Zero-Reformer	Other technologies
Captured and sold as by-product	256 kg/tDRI	0
Released to the atmosphere	159 kg/tDRI	~ 500 kg/tDRI
	62% selective CO ₂ emissions	100% non-selective CO ₂ emissions

plied to the process is taken up by the product, with minimum energy losses to the environment. It is therefore possible to achieve an efficiency above 78%, compared with below 70% for other, more conventional processes.

Moreover, Energiron includes a CO₂ capture system in its basic process. This allows to further decrease the emissions of the direct reduction plant by approx. 60%, leading to a carbon footprint of just 156 kg CO₂/t DRI.

The selectively removed CO₂ can be used in various other industries, for the production of soft drinks, dry ice, construction conglomerates or for enhanced oil recovery (EOR).

Using hydrogen to feed Energiron plants

While it is possible to produce high-grade steel more economically and

sustainably with Energiron technology, additional advantages can be achieved by feeding Energiron plants with hydrogen as a reducing gas, with no major changes to the proven ZR process.

New technologies (such as electrolyzes) are being developed to exploit renewable energy sources for production of hydrogen. In this context, Energiron is capable of using hydrogen. A major advantage is that reduction with hydrogen in Energiron reactors is more efficient and faster from the kinetics point of view: about five times as compared to CO-based reduction. Taking advantage of an additional reducing agent, this solution also allows to minimize CO₂ emissions. Finally, thanks to the Energiron technology, it is now possible to produce high-grade steel in an economic and sustainable way.

Compelling results in industrial use

Started in 2006, Energiron is a strategic alliance between Danieli and Tenova HYL aimed at developing and implementing the most efficient and flexible technology in the current panorama of DRI production, providing the lowest CapEx and OpEx in any environment. Due to compelling results achieved at such benchmark references as Emirates Steel DRI plants I and II (UAE), Suez Steel (Egypt), Nucor Steel Louisiana (USA), Ezz Steel (Egypt), the alliance has recently been renewed for an additional 10 years. Energiron technology is always a step ahead, offering the most advantageous way to use hydrogen, without changing its basic process scheme, for minimum CO₂ emissions steelmaking.

References

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Ironmaking

The Swedish fossil-free steel project is making progress

HYBRIT has ordered Norwegian electrolyzers for the fossil-free production of hydrogen to fuel the direct reduction plant at SSAB's Luleå site, Sweden. Also, the construction of the next generation pellet plant will start soon – a leap towards fossil-free production of iron ore pellets. LKAB is examining options for replacing the heating technologies used in the pellet process.



The HYBRIT initiative aims to develop the world's first fossil-free orebased steemaking technology (Picture: HYBRIT)

Hybrit Development, a joint venture between SSAB, LKAB and Vattenfall, has ordered a hydrogen generation electrolyzer solution to be installed at the pilot plant in Luleå, Sweden. In June 2018 a unique pilot plant was started to be built in Luleå, in the north of Sweden. The 4.5 MW alkaline electrolyzer solution from Nel Hydrogen will be part of this project. The pilot plant for fossil-free steel production will operate in Luleå, Sweden, from 2021 until 2024, then the project enters a demonstration phase with the goal to have an industrial process in place by 2035.

"We believe that HYBRIT can play a significant role to reach a fossil-free future. This order is an important step in our aim to develop a fossil-free iron and steel production process. The electrolyzer will be part of the pilot plant that we right now are building in Luleå. To ensure that we will reach our aims we need a high-quality and reliable hydrogen production plant and therefore we choose Nel," says Martin Pei, chairman at Hybrit Development and

executive vice president and chief technical officer at SSAB.

As an alternative to the conventional blast furnace route, the HYBRIT process is based on direct reduction of iron ore using fossil-free energy and hydrogen gas (H_2). Hydrogen gas is produced by electrolysis of water using fossil-free electricity. The hydrogen reacts with the oxygen in the iron ore and metallic iron and H_2O (water vapor) is formed.

"I am grateful to see how one more puzzle piece now will come into place. The production of the hydrogen gas is of great importance for the development of this new process and therefore this contract was a valuable contribution in the process ahead," says Markus Petäjäniemi, director of Technology and Process Development at LKAB.

Following a prestudy conducted in 2016 – 2017, the first sod was turned in 2018 for a pilot plant for hydrogen-based reduction of iron ore in Luleå. This plant, which is expected to be completed in 2020, will be

used to test processes downstream from the pelletizing plant.

Next generation pellet plant to be built in Malmberget

Construction will soon begin on a world-unique test facility at LKAB's Malmberget site. In the plant, fossil fuels will be replaced with biofuel to achieve fossil-free production of iron ore pellets.

Fossil-free steel production starts at the mine and LKAB is working hard to determine the design of the next generation of pelletizing plants. As part of the HYBRIT initiative a biofuel-based plant is to be built at LKAB's Malmberget site. This project will cost in the region of 80 million kronor. Testing a bio-oil system is part of the pilot phase and the objective is to convert one of LKAB's pelletizing plants from fossil fuel to 100-percent-renewable fuel. This means that fossil-generated carbon dioxide emissions from the Malmberget operation will be reduced by up to 40 percent during the test period, which corresponds to about 60,000 tonnes per year.

"Within HYBRIT, LKAB is examining options for replacing the heating technologies used in the pellet process, which are the heart of our processing plants. In parallel, trials will be conducted in an experimental facility in Luleå using an alternative heating technology. Trials will determine whether new biofuels and plasma burners will work in the unique setting of a pellet plant. Ultimately, this will make LKAB's iron ore pellets completely carbon-dioxide-free," says Jan Moström, LKAB's president and CEO.

The iron and steel industry is one of the sectors whose processes emit the most carbon dioxide in Sweden. A growing population in combination with greater urban-

"We are on our way to a revolutionary technical advancement showing the world that it is possible to produce steel without producing carbon dioxide emissions."

Martin Lindqvist, CEO and president of SSAB

ization means that demand for steel will continue to grow until 2050. If the HYBRIT initiative succeeds, Sweden's carbon dioxide emissions will decrease by ten percent.

"Together with our owners, we hope to be able to solve the problem of emissions in the iron and steel industry. The initiative is decisive for Sweden's ability to meet the targets set out in the Paris Agreement and nationally, and it is our contribution to battling climate change. Fossil-free production of iron ore pellets is an important step towards reaching these goals," says Mårten Görnerup, CEO, Hybrit Development AB.

The investment in a pilot-plant for bio-oil in Malmberget, which is an important milestone for HYBRIT and the development of fossil-free pellet production, is expected to be completed by 2020. The first tests will be conducted up to 2021.

"Vattenfall is looking forward to further collaboration. Our partnership with SSAB and LKAB is playing a very important role in the electrification of the industry and the development of fossil-free hydrogen to enable a fossil-free life within a genera-

tion," commented Magnus Hall, president and CEO, Vattenfall.

"We are on our way to a revolutionary technical advancement showing the world that it is possible to produce steel without

producing carbon dioxide emissions," said Martin Lindqvist, CEO and president of SSAB. "Work is proceeding according to schedule and I am confident that we will succeed. As a first step toward creating a fossil-free SSAB, we have decided to switch to an electric arc furnace in Oxelösund. This will entail decommissioning both blast furnaces in around 2025 and will reduce our CO₂ emissions in Sweden by around 25 percent," he said.

■ HYBRIT Development AB

HYBRIT – an initiative that will revolutionize the ironmaking and steelmaking technologies

Hybrit Development is a joint venture between the steel manufacturer SSAB, the mining company LKAB and the energy company Vattenfall. The objective of the joint-venture is to develop the world's first fossil-free, ore-based steelmaking process. The byproduct of using fossil-free electricity and hydrogen in steelmaking, instead of coke and coal, will be water instead of carbon dioxide. The initiative has the potential to reduce Sweden's total carbon dioxide emissions by 10 percent.

The project started during the spring of 2016, and the goal is to have an industrial process in place by 2035. A facility has started to be built in Luleå, north of Sweden, and soon the construction of a test plant for pellets will be built in Malmberget.

■ HYBRIT Development AB



GALVATECH 2020

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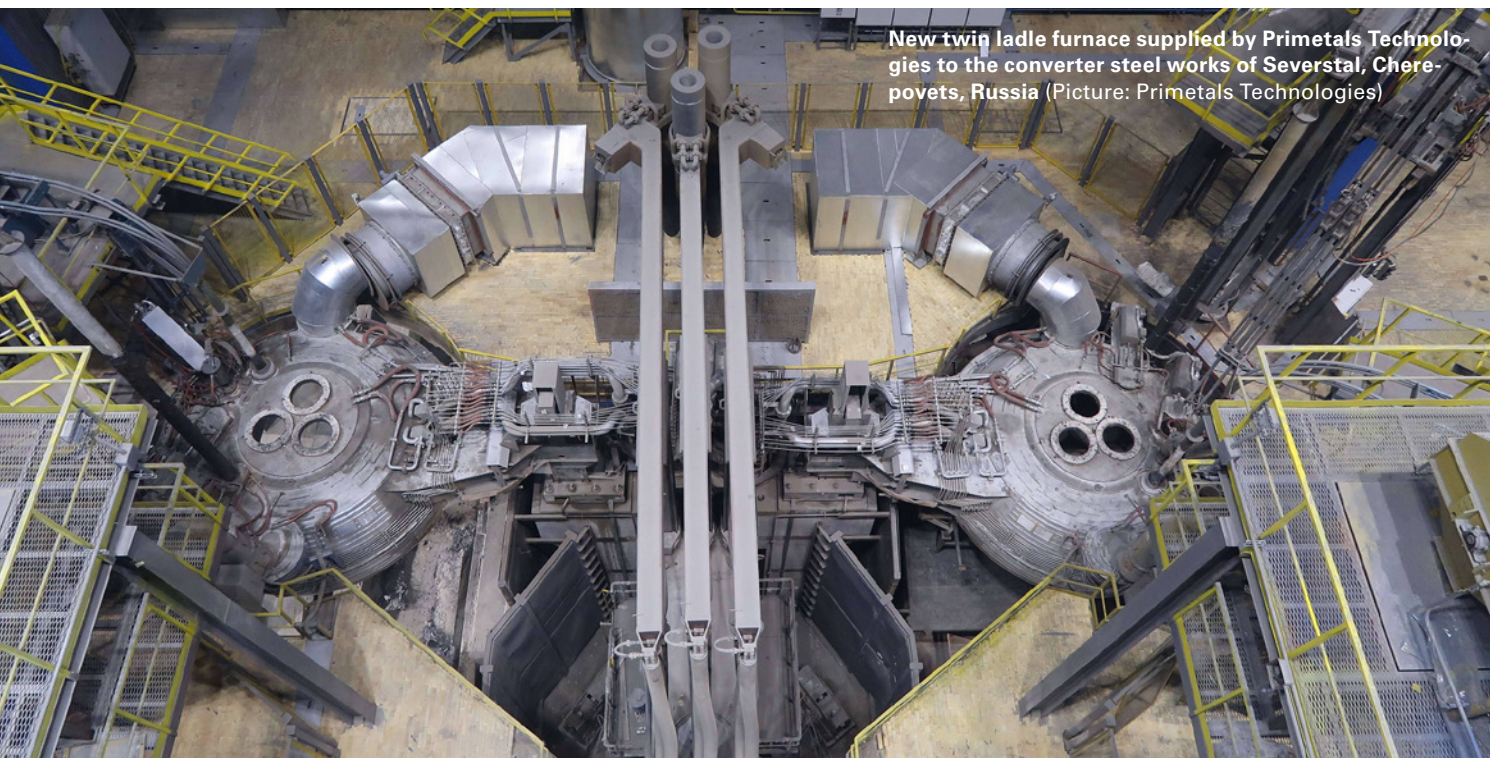
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Steelmaking - secondary metallurgy

Severstal has upgraded steel refining facilities at the Cherepovets steelmaking plant

The new twin ladle furnace with the capability to treat 4.8 million t of liquid steel per annum is featuring a high degree of automation through Level 2 process models. The consolidation of liquid steel treatment significantly reduces operating costs at Severstal.



Russian steel producer PAO Severstal issued the Final Acceptance Certificate for a new twin ladle furnace supplied by Primetals Technologies to the converter steel works in Cherepovets. The ladle furnace is able to treat 375 metric ton charges of liquid steel with a treatment time not more than 45 minutes, and has an annual capacity of 4.8 million t. This increases the production of converter steel from its previous maximum of 9.5 million to almost 10.3 million t per annum.

The additional ladle furnace also enables all the steel treatment to be brought together into a single section of the plant. This reduces annual operating costs by approximately 10 million euros.

The Cherepovets Metallurgical Plant in the Vologda region is part of the "Severstal

Russian Steel" Division of PAO Severstal and is one of the world's largest integrated iron and steel works. It produced around 11.65 million t of liquid steel in 2017. The steel is used to make a large number of end products, including hot- and cold-rolled flat steel, galvanized and coated products, and long products.

The Cherepovets converter steel works has three converters, each with a capacity of 350 t. Until now, only one ladle furnace has been available for treating liquid steel supplied by Primetals in the past. Primetals Technologies was responsible for engineering the twin ladle furnace, the alloying system, the dedusting system, and supplied key components. The scope of supply also included the associated electrical and automation

equipment. The installed Level 2 system has been seamlessly integrated in the plant's system and allows a high degree of automation due to the use of pre-calculated process models. In addition, Primetals Technologies supervised the installation and commissioning, and provided the staff training.

Severstal was responsible for the technical documentation development and the construction activities. The company invested approximately 43 million euros to expand of its treatment capacity. Severstal and Primetals Technologies can look back on many years of close cooperation.

Primetals Technologies

Steelmaking – secondary metallurgy

Maintenance of RH snorkels at Salzgitter Flachstahl GmbH

German steelmaker Salzgitter Flachstahl GmbH has implemented a gunning installation manufactured by VELCO GmbH for the refractory maintenance process of the snorkels at their new RH plant. The installation helps to fulfil the increased demands on productivity, occupational health and safety and improved working conditions for the operators.

The maintenance of RH snorkels constitutes a necessity for the safe operation of an RH plant. These must be deskulled, i.e. cleaned from slag in regular intervals and afterwards furnished with a protective layer inside and outside by using the gunning technique.

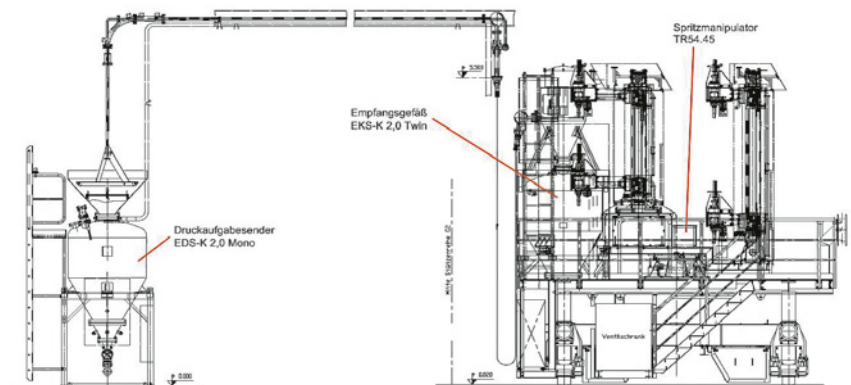
Two snorkel maintenance carriages are used for snorkel cleaning and each is provided with a snorkel deskulling device. The platform of these carriages can be used for manual gunning, too. The snorkel maintenance carriages move on rails and each one is dedicated to one RH plant.

A snorkel service carriage is installed between the snorkel maintenance carriages on the same rails. It can be used for both RH plants. The snorkel service carriage is equipped with a gunning manipulator with two lances (one for inside gunning and one for outside gunning) and a gunning machine with two outlets, one each for inside respectively outside gunning.

The feeding of gunning material to the snorkel service carriage is carried out pneumatically by means of a pressure vessel machine and a pipe/hose system. The refilling of the gunning machine with material is done automatically and dust-free. A recoupling of any hose is not required. In the first phase of construction the pressure vessel machine is filled by Big Bags, in a subsequent phase this can be modified to a silo filling.

The required compressed air, gunning water and electrical energy are fed to the snorkel service carriage via hoses respectively drums. A manual coupling is not required. The operator can either use automatic programmes or may control the maintenance process manually using a radio remote control.

VELCO GmbH, Velbert, Germany



The snorkel service carriage is equipped with a gunning manipulator and a gunning machine (Picture: VELCO)



Innovative special machines for steel plant maintenance

Optimized maintenance in steelmaking plants

Design engineers and technicians of German machine company Maschinentechnik Roth developed a unique machine that combines four different maintenance and repair operations in a single unit. The use of this machine saves time and thus helps improving the steel plant utilization. Also, the company provides outburst equipment that is exceptionally efficient.

Maschinentechnik Roth has been developing and constructing a unique machine for several years now. This universal machine – named KBSE – can perform all operations necessary for the tapping and maintaining of the converter: core-hole drilling, repair and mudding. Unlike common practice, it combines four operations in a single unit, whereas the conventional procedure deploys a number of machines or machine units.

The KBSE is well prepared for its task. The machine is mounted on an undercarriage with crawler tracks (usually rubber) and is operated using a radio-remote control. The cycle of operations can be described in short form as following.

At the beginning the operator moves the KBSE remotely in front of the converter and aligns it precisely in front of the tapping flange.

Using the drilling slide, the carriage drive unit moves the drill tube up to a position in front of the converter flange, the

rotation drive and the cooling water are activated, and the drilling operation commences at the set rate of advance. Drilling takes approximately 6 – 10 minutes.

After withdrawal of the drilling bit the slideway is retracted. The KBSE remains in its upright position and the transverse slideway is moved into the setting position. A mounting mandrel, onto which the new brickwork is positioned, is located on the positioning unit. The second carriage drive unit, bearing the positioning unit and the prepared brickwork, moves forward at high speed, and the new brickwork is inserted into the hole at reduced thrust force until the cover plate contacts with the converter flange.

Four commercially available captive-bolt pistols are then set up on additional slideways in the positioning unit. The captive-bolt pistols move forward in each case in pairs, the shot is triggered, the steel studs penetrate through the connecting plate. The captive-bolt pistols move back, a pivot system rotates through an angle,

and the next stud-setting operation can take place. This cycle is repeated until sufficient steel studs for fixing (generally 18 – 25) have been set.

After fixing, the positioning unit moves back to its starting position (setting and fixing take around 10 minutes). The KBSE is moved back for the refractory gunning operation, but remains in alignment wherever possible. The converter is rotated by around 90 degrees until the new repair kit is positioned. During this time, the hoses for refractory compound, water and compressed air are connected to the refractory gunning lance that is also mounted on the KBSE.

After rotation of the converter, the doors in front of the converter are closed, with the exception of a narrow gap. The VELCO telescopic refractory gunning lance is inserted through this gap into the interior of the hot converter and starts to perform the gunning operation. Refractory compound is used correspondingly economically, and the whole operation thus shortened, because the annular gap between the drilled hole and the outer diameter of the repair kits is optimum. After the gunning operation, the lance is retracted, the compound, water and compressed air hoses are disconnected, the KBSE moves into its parking position and can then be prepared for its next deployment.

Outburst equipment on standard excavator undercarriages

Decades of experience in the manufacturing of outburst equipment resulted in machine variants which, from the operators' viewpoint, have proven to be exceptionally cost-efficient: telescopic superstructures that are mounted on standard



The universal machine KBSE performs all operations necessary for the tapping and maintaining of the converter: core-hole drilling, repair and mudding (Picture: Maschinentechnik Roth)

excavator undercarriages. As a result the operator can procure spare-parts and get assistance provided by local service stations of the excavator companies.

The telescopic equipment is optimally designed for the undercarriage and utilises basic excavator technology (hydraulics). It consists, essentially, of the main and the outer and inner booms, together with the hydraulic cylinders. A top plate for fitting of attachments is located at the end of the inner boom. A fang with a replaceable tip is included as standard in the scope of supply (other attachments, such as hydraulic hammers, milling-cutter units and shears are also available). The fang is actuated by an attachment cylinder.

adherence to emissions and other environmental regulations. Potential uses are cleaning of ladles and converters, de-lining of ladles and converters, throat cleaning, slag handling, slag pit service. Further potential applications include tunnel engineering and salt mines.

The telescopic equipment is available in two versions. In the rigid version, two hydrau-

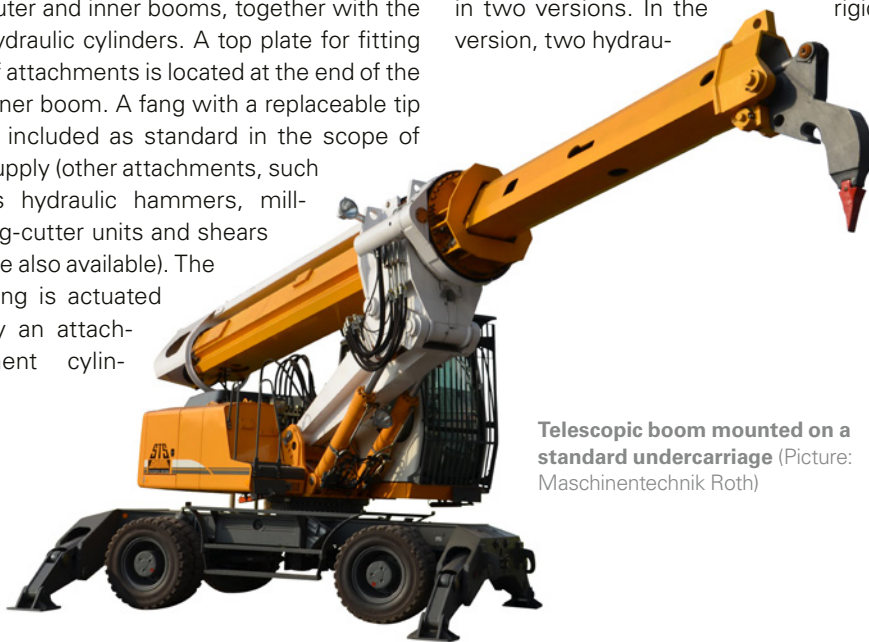
main boom provide a larger working range, particularly in the downward and upward directions.

The decision as to whether a crawler or a wheeled undercarriage should be selected depends on the particular application. An undercarriage with crawler running gear is recommendable where work is performed predominantly at a restricted location, such as a casting platform, for example. Where, on the other hand, work is conducted at a number of different locations and travel on works roads is necessary, a wheeled excavator undercarriage is more advantageous.

Conclusion

The use of the newly developed KBSE universal machine with the VELCO refractory gunning equipment achieves time savings of around 50%, depending on the previous working procedure. The individual machines and implements previously needed and their servicing/maintenance are no longer required. In addition to the economic benefits, the lessening of the heavy burden of work on the employees should also be noted, and particularly worthy of emphasis is, above all, the significant reduction of accident hazards.

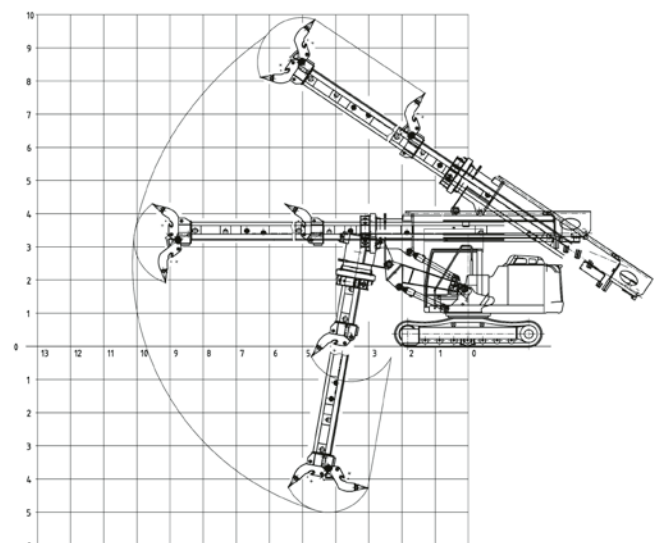
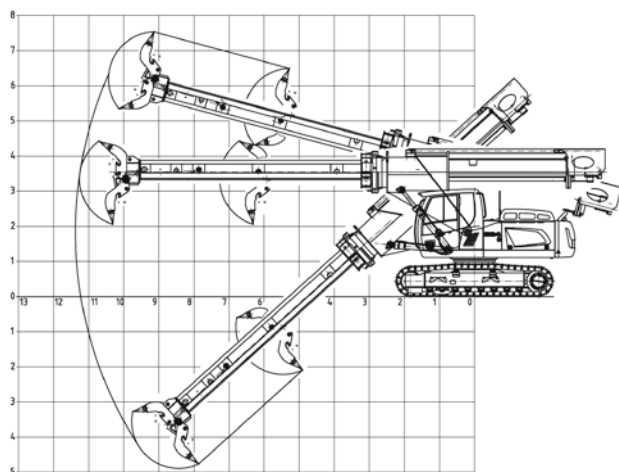
Maschinentechnik Roth GmbH & Co. KG, Hilden, Germany



Telescopic boom mounted on a standard undercarriage (Picture: Maschinentechnik Roth)

der. This cylinder is of a special type and is cooled during operation by the circulating hydraulic fluid. The scope of supply also includes the heat-shield system, the side and reversing camera with in-cab display, the central lubrication system and

lic cylinders installed underneath the main boom determine reach. This working range is generally adequate for the majority of tasks. If this is not enough, the folding version is available. Two additional hydraulic cylinders mounted above the



The folding version (right) of the telescopic boom has an optimised working area compared to the standard version (left) (Picture: Maschinentechnik Roth)

Continuous casting technologies for top quality results

Impressive start and performance for the new slab caster at voestalpine Stahl, Austria

Danieli was awarded the prestigious contract to supply the CC8 slab caster in January 2015 with the objective of installing a state-of-the-art machine able to produce crack-sensitive steel grades, predominantly for automotive and electrical applications.

The CC8 caster is designed to produce slabs with a nominal thickness of 225 mm and widths from 800 mm up to 1,820 mm. The initial range of products to be designated to the CC8 slab caster comprises steel grades as following:

- electrical steels (27%),
- ultra-low carbon steels (12%),
- low carbon steels (12%),
- structural steels (36%),
- press hardening steels (6%),
- high carbon steels (2%),
- special steels (5%).

Considering this specific product mix the single-strand machine has an annual design capacity of 1,200,000 t of slabs.

Hot start-up was achieved successfully in January 2018 following an extensive period of cold commissioning, and thanks to the quality and reliability of Danieli mechanical equipment and technological packages, in synergy with the experience and knowledge of voestalpine Stahl GmbH operating and maintenance teams, the caster was worked-up to full shift operations within five weeks of casting the first ladle.

Production has been steadily increased on CC8, as demonstrated by the impressive October 2018 results: with 103,000 t produced, equivalent to the design capacity of the plant, 95% of the product consisting of high-quality vacuum-treated steel, of which more than 80% was IF steel for the automotive industry.

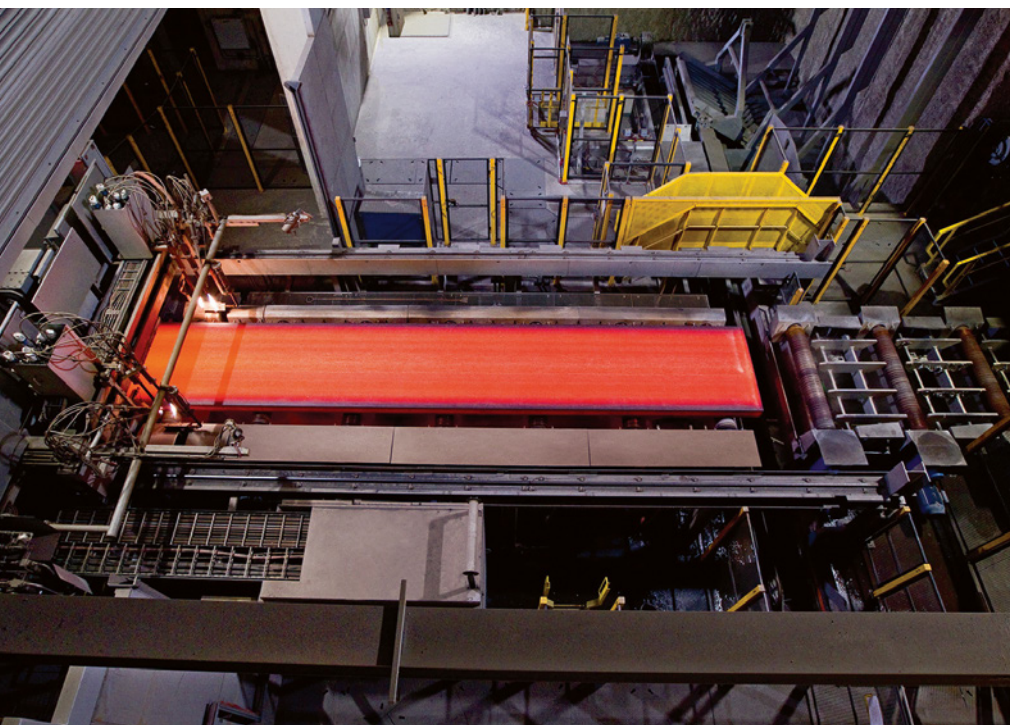
CC8 has been equipped with a full suite of the latest Danieli technological packages, including:

- multi-mode electromagnetic stirrer (MM-EMS),
- strand electromagnetic stirrer (strand-EMS),
- Q-COOL, Q-CORE and Q-ROBOT, all of which were commissioned successfully during the hot testing phase.

Mould multi-mode electromagnetic stirrer

Many years of experiments on continuous slab casters have established that an optimal steel flow pattern in the mould is mandatory to achieve the best surface and sub-surface product quality, minimizing the defects resulting from non-metallic inclusions and mould powder entrapment. CFD simulations and true-scale water modelling have been used to determine the natural flow associated with different casting conditions, i.e. casting speed, slab width, SEN immersion depth and Argon flow, as well as an extensive campaign of nail board tests to capture the steel flow direction and intensity at the meniscus.

According to these measurements the control functions of the multi-mode electromagnetic stirrer (MM-EMS) have been



The CC8 slab caster was worked up to full shift operations within five weeks after casting the first ladle (Picture: Danieli)

Gabriele Paulon, Danieli S.p.A.; Loris Busolini, Danieli Automation; Thierry Gautreau, Danieli Rotelec; Herbert Moser, voestalpine Stahl GmbH; Peter Hodnik, voestalpine Stahl GmbH

fine-tuned, and based upon quality results from the downstream process lines all contractual surface-quality performance guarantees have been fulfilled.

Strand electromagnetic stirrer

Moving from the mould down along the strand the focus shifts from surface and sub-surface to internal slab quality, and in order to improve the equiaxial zone extension a strand stirrer has been installed in the CC8 slab caster. The main reason for adopting the strand stirrer are the silicon steel grades with a Si content of about 2.32%, for which the equiaxed zone is enlarged by more than 50%.

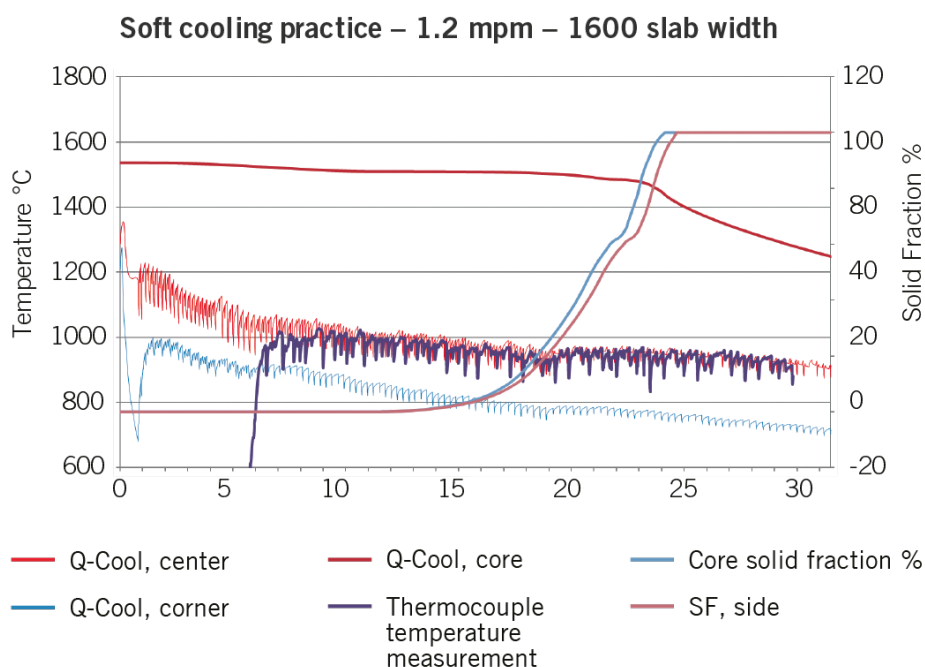
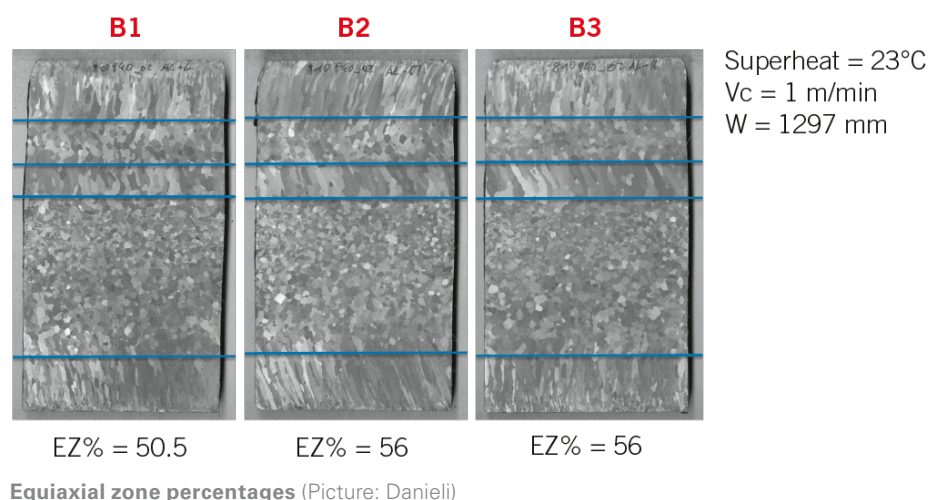
Dynamic secondary cooling system (Q-COOL)

To reach the required quality levels in terms of internal and surface quality for all the different slab sections, the cooling system for CC8 has been design to control in the smoothest possible way the water distribution across the entire slab width. For this purpose, the common arrangement in sprayed cooling sections across the width has been enhanced by adding the ability to control them independently by means of dedicated control loops with separate valves for air and water flow control.

The spray nozzles have been carefully designed to address the overlap effect across a single row and the total water density at the end of the spray cooling zone. Based on actual measurements performed by the nozzle supplier, each individual nozzle feature has been implemented within the detailed model so a full picture of the secondary cooling system is completely considered by the solidification model, providing a complete 3D map of the solidification conditions of the slab along the entire caster strand.

Dry casting

The product mix for CC8 includes a high percentage of crack-sensitive steel grades and in order to avoid the formation of cracks through the unbending zone it is important to maintain the slab temperature above the ductility trough ($> 900^{\circ}\text{C}$), and hence a dry casting practice is applied. CC8 is designed with tight roll pitches to ensure the proper containment to control bulging and segregation. The application



Surface temperature profiles, predicted and measured (Picture: Danieli)

of soft reduction has been tuned to achieve an even centerline quality even in the limited conditions given by the significant removal of secondary spray cooling.

Internally cooled PDR rolls, designed together with a controlled and tuned internal cooling water flow, have proven to be successful in reaching higher temperature values at the unbending area, with an acceptable distribution across the slab width. The internal quality results achieved are in line with contractual performance guarantees.

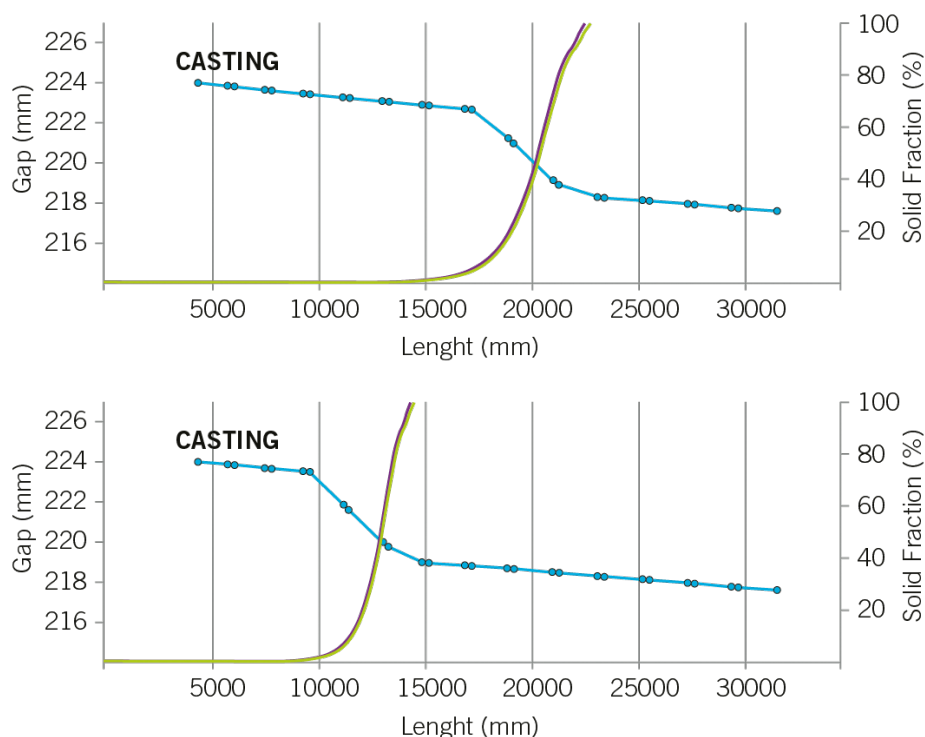
Dynamic soft reduction (Q-CORE)

An important role is played by the solidification model and the dynamic soft reduc-

tion control model, which have been merged into a unique advanced model that controls spray cooling flows and segment position dynamically, according to the different casting conditions, either steady and unsteady.

The development of a meshless algorithm to compute the heat exchange equations makes it possible to reduce the computational time enough to allow handling of a full two-dimensional slice model in real-time conditions.

Therefore, it is possible to simulate the behavior of each individual nozzle across each sprayed row to attain a full map of the cooling behavior over the entire slab surface, and a full picture of the solidification progress within a slab



Segment gap in casting condition applying soft-reduction at 1.3 m/min (top) and 0.8 m/min (bottom) (Picture: Danieli)

section at any distance from the meniscus.

Coupled with a flow control split across the sprayed width the model allows a fine-tuned control of the temperature distribution to reduce the differences across the width.

Coupled with the slab cooling control the model integrates the functions for applying dynamic soft reduction (Q-CORE) so that, according to the different steel compositions, different thickness reduction profiles can be dynamically applied on the three main areas of liquid core, mushy core, solid core.

Operational results

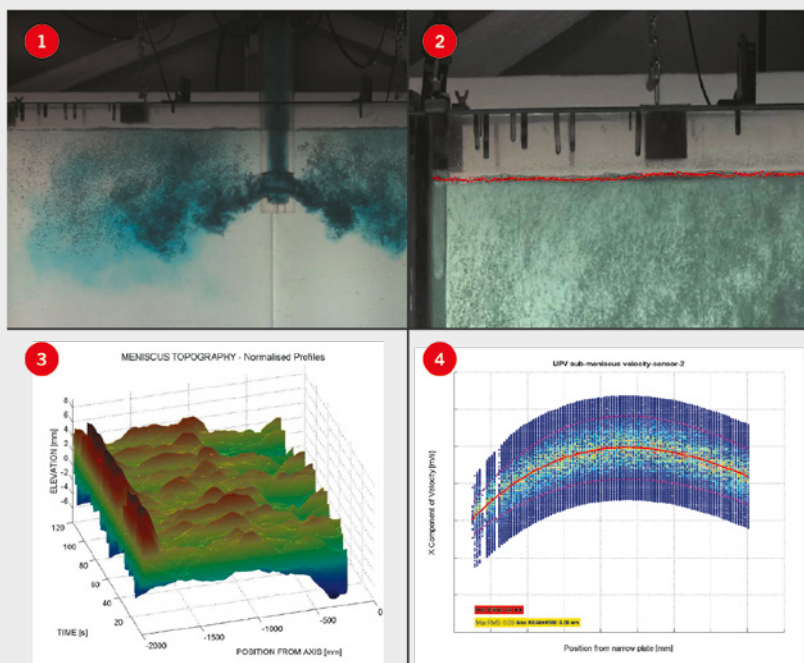
Operational results for CC8 have been impressive: In October 2018 the caster produced 103,000 t of slabs, which is its nominal capacity, and 95% of this output was high-grade vacuum-steel, of which more than 80% were automotive-grade IF steels.

Since October CC8 has cast approximately 260,000 t of hot steel against a nominal monthly production of 100,000 t. During previous months significant results already were achieved in terms of machine reliability by casting 101 heats in a sequence with 16 fly tundish changes. These results confirm the sound design of Danieli CC8 caster, which is considered available for scheduled production now very soon after the start-up.

Conclusions

Thanks to the quality and reliability of the Danieli mechanical equipment and technological packages, in synergy with the experience and knowledge of voestalpine Stahl GmbH, the new CC8 continuous slab caster has exceeded all expectations both in terms of productivity and product quality during a highly successfully work-up period, and now has been accepted for full production.

These impressive results are only possible due to the extremely strong teamwork between the voestalpine and Danieli project teams and are a testament to the hard work and detailed planning undertaken by all involved. At present CC8 slab caster is completely integrated in voestalpine steel works No. 3 plant.



The water model is used to study the natural flow pattern of liquid steel into the mould. Argon injection is modelled thanks to air injection in the stopper rod and the flow is traced with methylene blue (1). The meniscus shape is detected through digital camera level topography (2) and the results are analyzed to reconstruct the wave (3). Sub-meniscus velocities are measured with an ultrasonic velocity profiler (4), allowing a complete characterization of the flow pattern. (Pictures: Danieli)

Continuous casting

New 2-strand slab caster and ladle furnace in full operation at Ilyich Steel, Ukraine

With this investment Ilyich Steel increases annual production capacity to 4 million t of slabs. The company has expanded the product portfolio and has also reduced the dust emissions thanks to a new off-gas cleaning plant

In late March, Ukrainian steel producer PJSC Ilyich Iron and Steel Works of Mariupol (MMKI, Metinvest group) issued the Final Acceptance Certificates (FACs) for a two-strand continuous slab caster, a twin ladle furnace with an alloying station, and the associated dedusting system, all supplied by Primetals Technologies. The two-strand caster CC4 is designed to produce 2.5 million t of slabs per year. This increases Ilyich Steel's annual production capacity to around four million metric tons, as well as enhancing and expanding its product portfolio to include, for example, HC, UHC and ULC steels. A Level 3 heatpacing solution coordinates the steel production with the casting operation.

Ilyich Steel produces steel with three LD (BOF) converters. A new 150 t twin ladle furnace from Primetals Technologies and the associated alloying station help to

set the desired steel grades and the correct casting temperature. Due to an Industry 4.0-ready automation on Level 1 and Level 2, this can be done via pre-selectable process models. A transformer with a rated power of 28 MVA provides the electrical energy for the ladle furnace, enabling a heating rate of 4.5°C per minute. This heating rate and the guaranteed energy consumption value have been over-fulfilled during start-up.

Primetals Technologies designed a dedusting system to clean the off gases from the ladle metallurgy facility. This improves the environmental situation in the city of Mariupol, where MMKI is located. The dedusting system reduces the dust content in the off gases to a level of 12 mg/m³ (maximum), whereas the Ukrainian standards require up to 50 mg/m³ and the European standards up to 30 mg/m³.

Cross-section heat-pacing solution to coordinate liquid steel production with casting operation

The equipment order for the continuous slab caster covered all the installations from the ladle turret and the tundish car through to the exit zone with its weighing, torch cutting, marking and deburring machines.

The caster from Primetals Technologies has a machine radius of nine meters and a metallurgical length of 29.8 meters. It casts slabs with thicknesses of 170 and 250 millimeters in widths ranging from 900 to 1,550 millimeters. The maximum casting speed is 2.2 meters per minute. It processes peritectic and peritectic alloyed steels, low, medium, high and ultra-high carbon grades, as well as medium-carbon alloyed steel. The caster is equipped with automatic LevCon mold level control, a straight, cassette-type Smart Mold with the DynaWidth technology package to automatically adjust the width of the slab online, and the DynaFlex mold oscillator. The strand guide is equipped with Smart Segments and I-Star rollers.

DynaGap Soft Reduction, the Dynacs 3D secondary cooling model, and DynaJet nozzles was also installed, making it possible for Ilyich Steel to produce a wide variety of high-quality grades with improved interior quality of the slabs.

Ilyich Steel is one of the largest iron and steel works in Ukraine. The company produces a wide range of flat products made of carbon, low-alloyed and alloyed steel grades for various applications. These include heavy plates for pipelines, shipbuilding, pressure vessels and the construction industry, as well as hot and cold rolled plates and coils.



The two-strand caster CC4 is designed to produce 2.5 million t of slabs per year (Picture: Primetals Technologies)

Primetals Technologies

Simulation of ingot and continuous casting

Aiming for processes with optimized quality and robust productivity

The application of powerful simulation programmes for predicting flow and solidification processes in ingots and continuous castings has become an established technology to assess process conditions and to predict microstructures and casting defects.

Casting process simulation is a well-accepted tool to teem, solidify and cool an ingot virtually, providing critical information for the layout of the casting process and the mold design before the first product has been made [1 – 5]. In addition to the simulation of filling and solidification of the ingot, many further aspects such as ingot macrostructure and different segregation phenomena are considered (figure 1).

When simulating continuous casting, process specific phenomena like the inflow of the melt from the tundish, the gap formation between the strand and the mold, and the secondary cooling must be considered accurately to understand the heat extraction from the strand. Available models can describe both quasi-stationary and transient withdrawal processes.

For both casting processes, the formation of various casting defects can be simulated. This includes the prediction of shrinkage cavities, centerline shrinkage, macro-segregation, the size and distribution of re-oxidation inclusions and the formation of cracks due to thermally induced stresses and strains.

Autonomous engineering is a new methodology, which makes use of individual simulations for systematic virtual

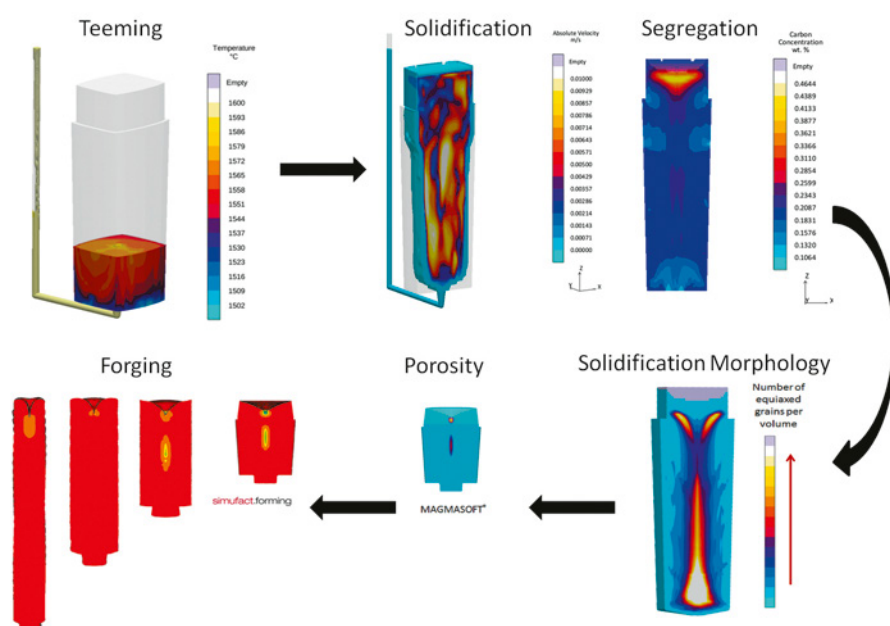


Figure 1. Casting quality can be predicted comprehensively and used as an input for subsequent manufacturing processes such as forging (Picture: MAGMA GmbH)

experimentation (designs of experiments) or even for genetic optimization. This allows the automatic evaluation of the casting production from both the quality and the cost/productivity perspectives. Autonomous engineering provides quantitative insights to clearly identify the most

relevant process parameters for product quality. It also allows evaluation of the sensitivity of any quality criterion simulated to varying process conditions. This aids the expert in the set-up of robust, cost-effective processes for ingots or strands, ensuring a high quality product while at the same time balancing the often competitive requirements on quality and productivity.

For the setup of an optimization task, the software aids the user in defining objectives (e. g. minimize a certain defect in the ingot or optimize the metallurgical length of the strand). Subsequently, the expert decides upon the process window to be investigated (e. g. variation of geometrical dimensions, temperatures, teeming/pouring rates, alloy chemistry, cooling layout) and defines different quality criteria to assess the results. The software sets up a sequence of virtual exper-

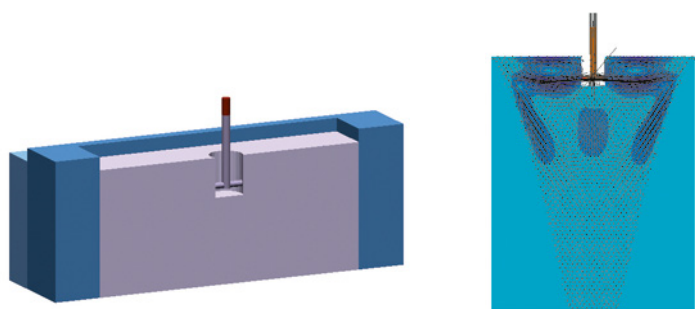


Figure 2. Geometry of mold and strand showing the flow field in a rectangular format with a T-shaped nozzle design (Picture: MAGMA GmbH)

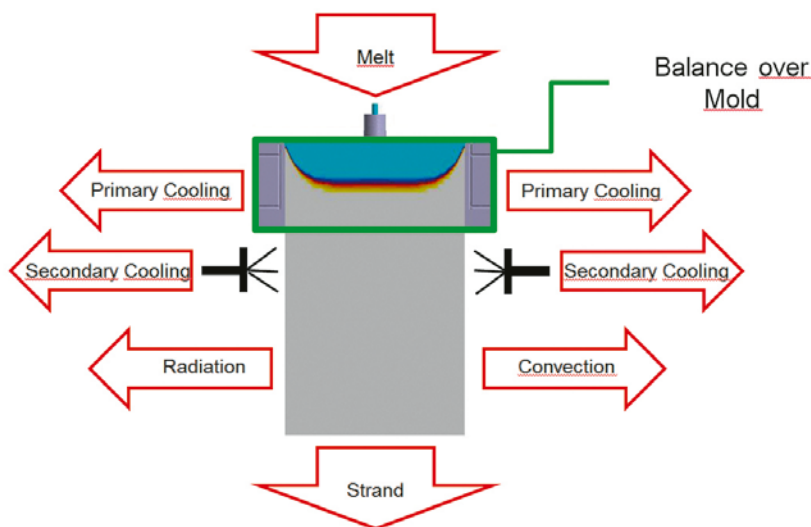


Figure 3. Main sources of heat input and extraction considered to determine the mold efficiency factor as a quality criterion (Picture: MAGMA GmbH)

iments similar to a “design of experiments” (DoE) in real plant trials. Statistical methods are used to aid the engineer in gaining comprehensive information with a minimal computational effort. On top of this, a true autonomous optimization can be carried out using genetic algorithms to propose an optimal operating point for the casting process.

Improving the mold effectiveness in continuous casting

Many objectives in continuous casting processes concern increasing productivity without compromising with the quality of the product. The set-up and control of the cooling conditions in the mold play an important role in this respect. The efficiency factor of the mold, which is defined as the ratio between the extracted and the incoming heat (from the melt) can be used as a controlling quality criterion to measure the outcome. Using a virtual design of experiments (DoE), the variation of process parameters provides quantitative insights to identify main effects on the efficiency factor. In the following example, a process window was chosen by varying the casting temperature from 1,175°C to 1,245°C, the casting speed from 40 to 120 mm/min and the primary cooling from 0.12 to 0.48 m³/h in discrete steps. The full factorial DoE resulted in a total of 60 virtual designs which were calculated. As quality criteria, the sump depth and the efficiency factor were measured automatically. **Fig-**

ure 2 shows the geometry of the nozzle, the mold and the strand, and a typical velocity distribution in the melt for this arrangement during the withdrawal process.

Apart from setting clear objectives, variables and quality criteria, an important step is to minimize the required computational effort. As the main focus of the investigation was on the cooling power of the primary cooling in the mold, it was not necessary to calculate the heat balance for the total process including the secondary cooling (**figure 3**).

As one option to evaluate the virtual DoE, a main effect diagram clearly shows

that the casting speed is the main influencing parameter for the mold effectiveness, whereas the casting temperature shows only a minor influence (**figure 4**).

For a further assessment of the results, a parallel coordinates diagram can be used. **Figure 5 (left)** shows the results of all 60 simulated designs in one diagram. Each coloured line represents the defined values of the selected variables and the resulting quality criteria for one virtual experiment. In this diagram, the user can interactively filter both the process parameters and the objectives according to his targets.

By applying a filter to the objective “mold effectiveness” with a typical range of 40% to 45%, the number of feasible designs is reduced significantly. A further restriction in the casting temperature depicts one possible design as the final result (**figure 5, right**). The respective casting speed of 60 mm/min should be used.

Variation of steel chemistry and ingot taper

The ingot taper for ingot casting processes has a strong effect on the formation of centerline porosity. Steelworks lay out molds using a taper in order to avoid defects in the centerline and in the lower part of the ingot. Autonomous engineering can be used to understand the interaction of various parameters that have an influence on the formation of centerline defects. In a systematic

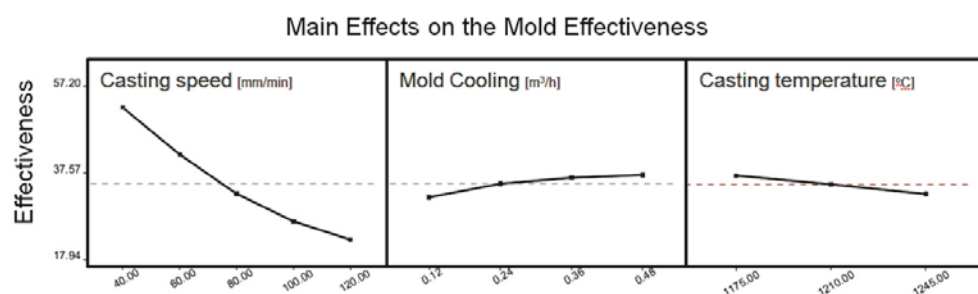


Figure 4. A main effect diagram shows the influence of the varied process parameters on the defined objective, which in this case is the mold effectiveness (Picture: MAGMA GmbH)

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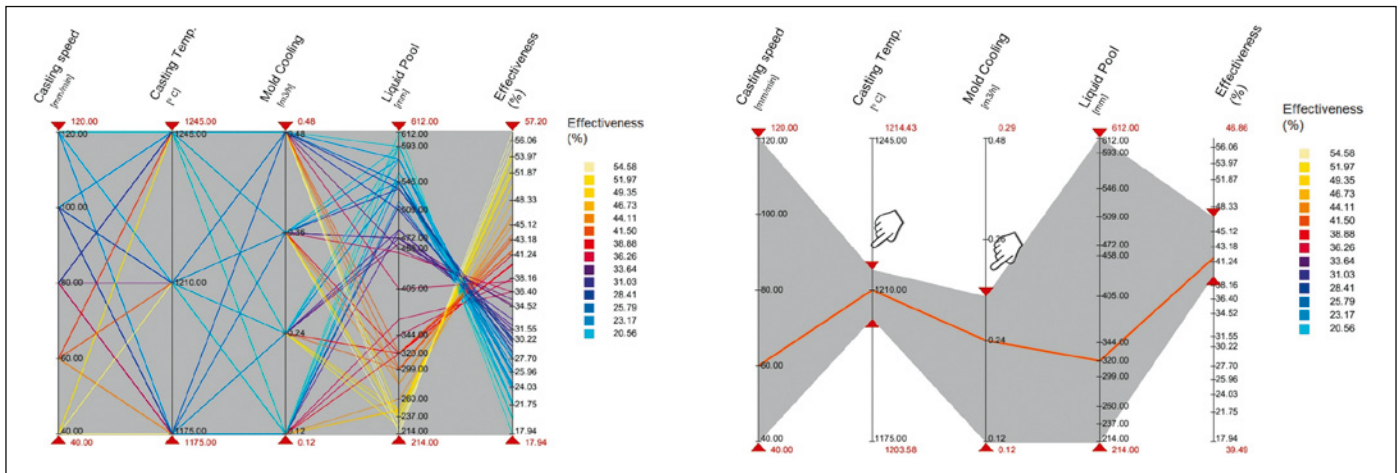


Figure 5. Parallel coordinate diagram allowing an interactive manipulation and filtering of the results (Picture: MAGMA GmbH)

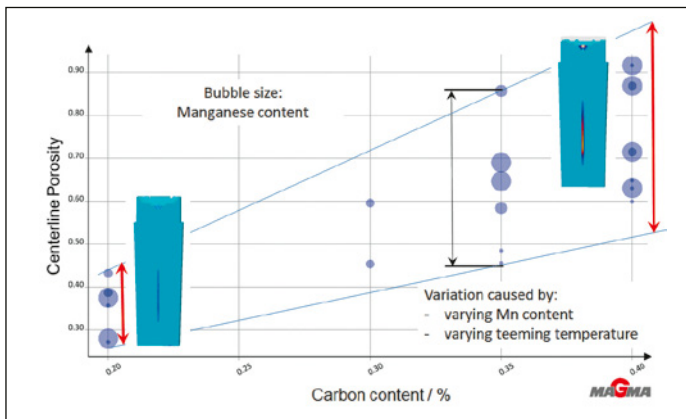


Figure 6. Influence of carbon content on centerline porosity. For each given carbon concentration, a scatter is observed, resulting from the variation of manganese content and teeming temperature. The scatter for the lowest and the highest carbon content is marked by red arrows. Castings with a higher manganese content are marked by bigger spheres (Figure: MAGMA GmbH)

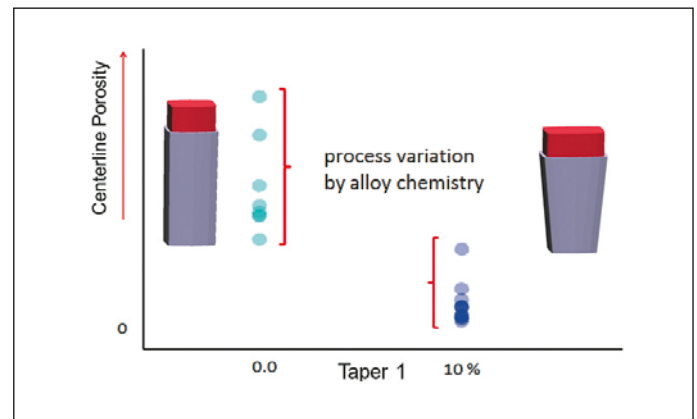


Figure 7. Influence of ingot taper and alloy chemistry on centerline porosity. Applying a taper in the mold not only reduces the overall tendency to forming centerline porosity, but also leads to a more robust set up against variations of the other process variables such as the melt chemistry (Figure: Magma GmbH)

test using virtual experiments, the carbon and carbon content of a steel grade were varied. This was done for two equal sized ingots, one without taper and one with a taper of 10%. In this investigation, again 22 virtual casting experiments were carried out.

Figure 6 shows how the alloy chemistry affects the centerline porosity. It is obvious that for increasing carbon concentrations, the tendency for centerline shrinkage increases, as the possible feeding distance gets shorter with increasing alloying content. The scatter for a given carbon content results from the variation of the manganese content of the melt, the variation of the teeming temperature and the difference in taper of the mold. As shown in **figure 7**, this scatter itself is reduced by increasing the ingot taper. The centerline quality of the cast ingot becomes more

robust against variation of steel chemistry when the ingot is tapered.

Conclusion

Autonomous engineering is a new and innovative methodology using systematic virtual experimentation to design robust casting processes. It provides quantitative insights into main effects between process variations and the resulting product quality or productivity. As systematic virtual experimentation can be performed offline from the production, it relieves continuous casters as well as ingot producers from the necessity to excessively carry out costly real trials. This allows manufacturers to focus on process robustness while at the same time fulfilling cost and quality requirements without production risks.

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Long products

Continuous billet caster successfully revamped at Feralpi Siderurgica in Italy

With this investment the Italian steel producer increases production capacity by 10 percent to 1.2 million t per year. Billet cross section has been raised to 150 mm x 150 mm with predisposition for 160 mm x 160 mm. Also, plant availability has been increased.

Recently, a six-strand billet caster revamped by Primetals Technologies was started up in the Lonato del Garda works of Feralpi Siderurgica S.p.A., part of the Italian Feralpi Group. The aims of the project were to increase production capacity from 1.1 to 1.2 million t of billets per year, to produce billets with a larger square cross section of 150 mm x 150 mm with predisposition for cross section of 160 mm x 160 mm, and to improve plant availability.

Before the revamp, the six-strand billet caster of Feralpi Siderurgica in Lonato del Garda in the Brescia Province, had an installed annual capacity of 1,1 million t of billets with a square cross sections of 140 mm x 140 mm. It produces medium

carbon, carbon and low alloyed steels for the construction industry. Within the revamping project, the casting machine was equipped with new DiaMold high-speed casting molds, characterized by tapered mold tubes and open bottom-mold corners to reduce strand friction. The DynaFlex hydraulic oscillator with online and flexible adjustment of the mold-oscillation parameters serves to improve strand-surface quality. The scope of supply included a new secondary cooling and a dummy bar head and the existing straightener has been modified according to Primetals Technologies' model of continuous straightening to optimize the straightening strains. Primetals Technolo-

gies was responsible for the basis, detail engineering and supply of the above components.

Feralpi Group is one of the most important steel suppliers to the European construction industry. The group operates four subsidiary companies in Italy and runs production and sales locations in Europe and North Africa. Feralpi Siderurgica was founded in 1968 and is thus the oldest member of the Feralpi Group. The company is today one of the leading suppliers of reinforcing steel, wire rod, reinforcement meshes and the associated derivatives in Italy.

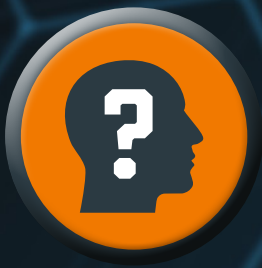
■ *Primetals Technologies*



Continuous billet caster modernized by Primetals Technologies in the Lonato del Garda, Italy works of Feralpi Siderurgica (Picture: Primetals Technologies)

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Long products

Jindal Shadeed commissions high-speed billet caster in Oman

42 heats in sequence could be cast within just over a month after start-up, which represents an impressive ramp-up curve.

Jindal Shadeed Iron & Steel LLC (JSIS), a company of Jindal Group, in Sohar, the Sultanate of Oman and SMS group have successfully put a new high-speed billet caster with six strands into operation.

The continuous casting machine was designed and commissioned in cooperation with SMS Concast, a company of SMS group. It is currently operating with six strands and produces rebar billets of 165 millimeters square section at a casting speed of 3.6 meters per minute. However, provision is made for eight strands and square billets with a section range from 130 up to 200 millimeters. These billets shall be produced at casting speeds ranging from 1.0 to 5.0 meters per minute and shall reach an annual capacity of 2,000,000 tons. Apart from the integrated CONVEX mold technology, it is planned to install further technological solutions by SMS Concast in order to enable the production of SBQ steel grades. These grades need a closed casting mode with submerged entry nozzles. In this mode, the future CONFLOW stop-

per control will optimally ensure a stable steel flow. In order to achieve the desired high-level steel qualities, the application of electromagnetic mold stirrers is on the agenda, too. The integration of CON-STIR-MEMS electromagnetic stirrers permits product quality control to be improved in terms of center segregation and center porosity.

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 four months from first major equipment delivery to site: "Thanks to the great cooperation of the project teams, we were able to cast 42 heats in sequence within 45 days after commissioning."

■ SMS group, Düsseldorf, Germany



New high-speed billet caster operating at Jindal Shadeed Iron & Steel shortly after start-up (Picture: SMS group)

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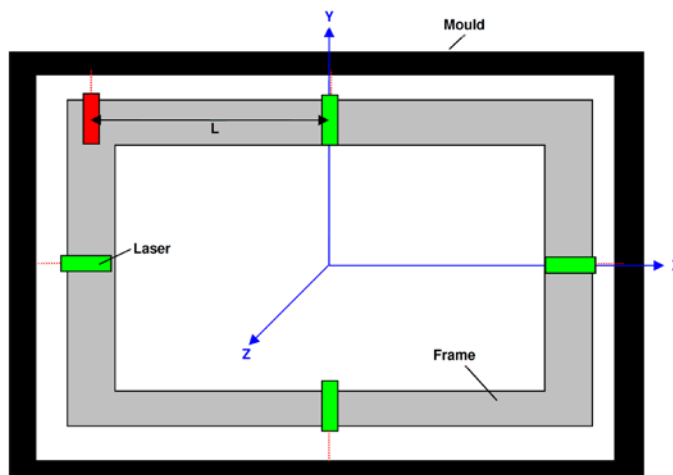
Alignment of continuous casting machines

Monitoring the transition between the mould and the first caster segment

The MouldAlign system developed by Gassen Instruments is made to measure the mould surface and especially to monitor the transition of the mould in reference to the first strand segment of the casting machine.

Moulds get set-up and adjusted regularly in the mould workshop. The segments are assembled and thoroughly adjusted in the segment workshop. But the perfect functional interaction of both the mould and the first caster segment must be achieved on the casting platform. Typically mechanical measuring gauges are used to achieve an acceptable alignment from the mould to the first segment. These mechanical utilities have a limited accuracy which may add up to unreasonable errors. But the larger issue is that the operator influences the measuring results with the handling of the gauges. That means finally that the results are person dependent, which is not acceptable for a quality measurement. The same is valid for wear-out measurement at moulds mounted on the casting floor using the same type of mechanical gauges.

The MouldAlign system is the final solution to avoid these kind of issues. The



Measuring principle (Picture: Gassen Instruments)

MouldAlign system delivers operator independent high precision laser measurement data from the mould and the first caster segment. In addition to the 12 laser sensors (max.) two inclinometers may give the absolute positioning in space to all the data.

The MouldAlign system is available for slab, bloom and billet casters. The measuring task may vary and the number of sensors can be chosen individually according to the specific task.

The measurement is performed fully automatically without any operator action required. The data which are retrieved during the measurement are stored on a USB stick for further evaluation on a PC. A powerful evaluation and visualization software is part of the package as well. The data may be transferred via Wi-Fi to the PC as an option.

Sample application at a bloom caster

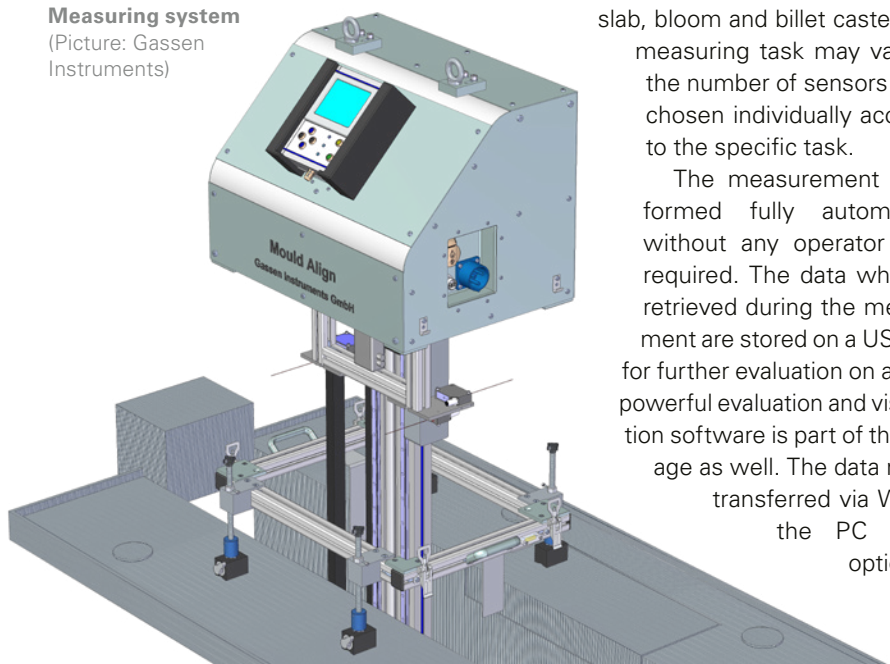
The MouldAlign system indicates the alignment position of the mould in a bloom caster machine. In this case the position of the mould in X and Y direction related to the first strand segment and the rotational position around the Z axis will be determined.

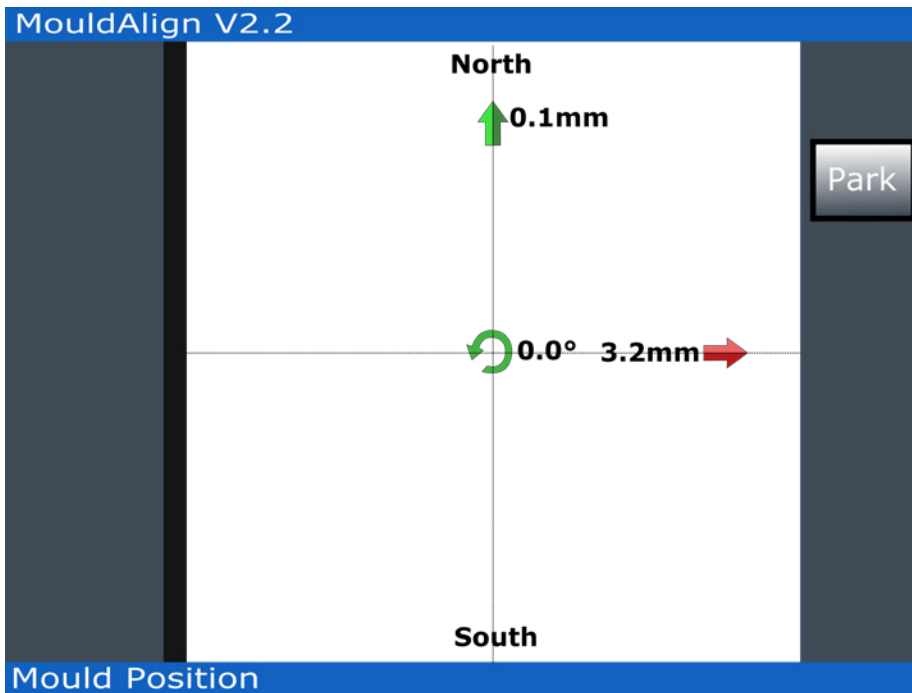
Two high precision lasers are mounted on a frame in each direction (X and Y axis). An additional laser is mounted off the middle axis. This laser enables to detect a rotational misalignment through the lateral distance "L". The measurement frame moves fully automatically into the mould. The measuring system is doing an automatic referencing in relation to the mould at two heights of the frame. This is done for the X and the Y axis and in relation to the rotational position. After doing so, the measuring frame is moving down to the level of the first segment rollers. The position of the rollers is taken in relation to the mould position in X, Y and Z axis.

The remote user interface is used for control of the measuring system. The user interface is giving clear intuitive guidance

Measuring system

(Picture: Gassen Instruments)





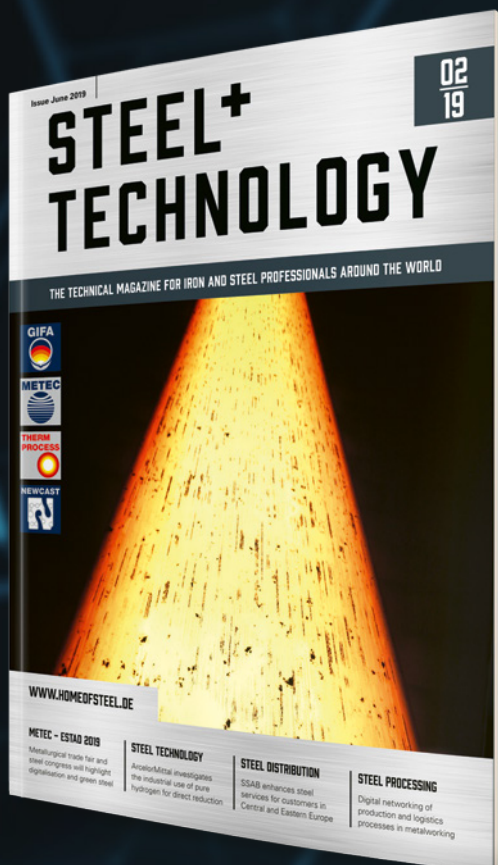
Alignment instructions (Picture: Gassen Instruments)

which kind of operator actions are requested to adjust the mould properly. The operator gets explicit instructions how to move or turn the mould to achieve a proper positioning. The tolerance range of the adjustments can be determined.

Conclusion

The MouldAlign measuring system enables for the first time to gather comprehensive information about the mould condition and how the mould is aligned to the first caster segment. These important and quality-relevant data were not available in the past. It overcomes the limits of mechanical gauges which deliver operator dependent data that are not suitable for quality-relevant monitoring.

■ Gassen Instruments GmbH, Duisburg, Germany



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Digitalization in steel and rolling mills

Online monitoring of the slab temperature during hot transfer

An integrated iron and steelworks has been using an online temperature model to monitor the slab temperatures during hot transfer. This has improved process security of the hot transfer and makes for uninterrupted, model-based monitoring of the slab condition – an important step towards a digitalized steel mill.

Hot transfer of slabs

The transfer of slabs from the steel plant to the rolling mill is subject to specific material-dependent rules. If a long distance has to be covered from the steel plant to the rolling mill, the slabs are covered by heat retention hoods during the transport (**figure 1**). From the point of materials technology, various aspects must be considered, including that:

- carbon steel slabs tend to cracking if cooled at too high rates,
- ferritic chromium steel slabs must be charged hot,
- slabs of high-Si steels (dynamo and transformer grades) have a very coarse-grained microstructure (pure ferritic solidification). This type of slabs fall in the same category as ferritic chromium steels,
- when subjected to mechanical stress (e.g. during crane transport) the slab temperatures shall not be within the

range of the second and third ductility minimum,

- intensively cooled slabs do not develop a martensitic microstructure,
- in ferritic steels the decrease in impact work is greater than in austenitic steels.

Online monitoring of the slabs during hot transfer

At the integrated steelworks, slabs of stainless, titanium-stabilized ferritic steel are transferred from the meltshop to the hot rolling mill. In order to ensure that the slabs are in a condition adequate for rolling, they must be charged into the reheating furnace at specific temperatures. During the transport the slabs are covered by heat retention hoods in order to avoid excessive cooling of the slab surface.

During the hot transfer, use is made of STT (Slab Temperature Tracking), an online temperature model which simulates each slab's temperature along its transfer route,

starting from the torch cut in the discharge of the continuous caster via the hot transfer down to the slab piles ahead of the reheating furnace at the rolling mill. The use of the model provides the great advantage that no measurements have to be taken to know the temperatures of the slabs under the heat retention hoods during the transport and in the slab storage area [1].

The temperature profiles of all slabs are at any time available for retrieval, for example, to plan the subsequent production. For a consistent quality control process, STT stores the calculated temperatures also in the data system of the works. Any incidents of missed limit values will be signaled and stored. The model will also trigger messages when slabs are reaching times or temperatures that are critical for the next downstream processing step. This function makes it possible to give preference to hot transfer cars carrying slabs of lower temperatures and to react to unforeseen circumstances. STT makes the overall process of hot slab transport safer and more predictable.

Three application variants of the STT process model

The STT process model simulates a temperature field for each slab, taking into account the currently prevailing circumstances, such as piling situation, hot transport, water cooling, etc. It allows the temperatures to be tracked from the slab discharge and handling

Table 1. STT model variants

Variant	Task	Data sources
Simulation	Planning of slab temperature control from the torch cut down to the reheating furnace	Data provided by the operator
Process	Presentation of the current cooling process during the slab transport, supported by slab logistics and temperature control	Data from the current slab transfer
Replay	Review of the cooling process (e.g. in case of irregularities)	Stored process data

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Figure 1. Hot transfer car with slabs (Picture: SMS group)

area via the slab store down to the charging of the slab into the reheating furnace. The simulation takes into account:

- thermos-physical material properties based on the chemical composition of low and high-alloyed steels,
- the slab geometry,
- the arrangement of the slab piles and the positions of each slab within a pile,
- the geometry of the covering hoods, insulated roller tables and/or water basins,
- process data, including the transfer speed, data from tertiary cooling (spray cooling, retarded cooling, etc.) and other data relevant for the description of the process route.

er data relevant for the description of the process route.

The model determines the values used in the calculations for the circumstances changing with time for each step of the process chain [2].

The X-Pact® Solid Control simulation model developed by SMS group provides

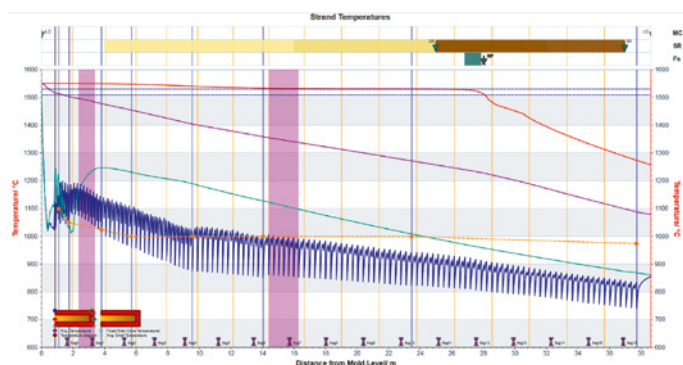


Figure 2a. Curves of the core temperature, average temperature and surface temperature of the strand during continuous casting (Picture: SMS group)

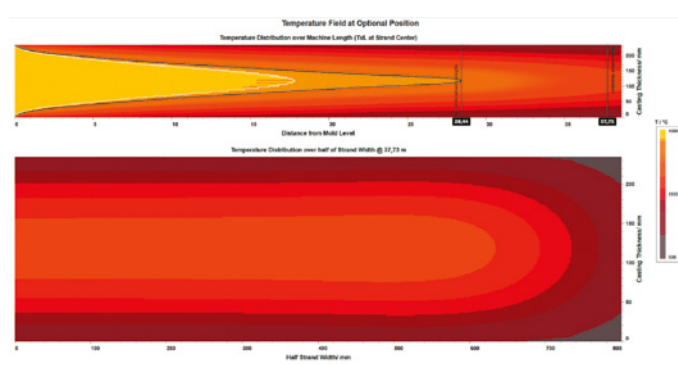
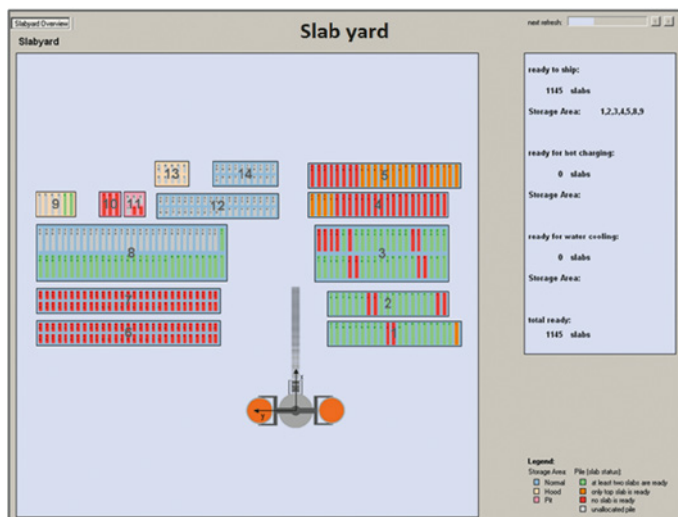


Figure 2b. Temperature profile of the slab at the caster end (Picture: SMS group)



rolling mill must not have cooled down below a defined minimum temperature when being charged into the reheating furnace. This prevents slabs from cracking before and during the reheating process in the furnace (**figure 5**). For the critical titanium-stabilized ferritic steel this minimum temperature is 200°C. Should the slab be charged at a lower temperature into the reheating furnace, there is the risk of defects occurring in the transfer bar during hot rolling. The reason for this is the limited formability of the material, which also shows in the declining impact work when the material cools down.

Residence times. Slabs to be hot charged lose heat during the transfer and in the piles ahead of the reheating furnace. The question: “How long may the slabs stay under the hood of the hot transfer car and later on in the pile before the minimal permissible temperature has been reached?” was answered by off-line simulations (**figure 7**), and has improved process security as a result.

Phase transformation at the slab surface. In hot charging practice, low-carbon steel slabs featuring partial transformation will suffer surface cracking during reheating unless the following measures are taken before charging the slabs into the reheating furnace:

- holding the surface temperatures of the slabs (including at the edges) above the Ar₃ transformation temperature (austenite-ferrite),

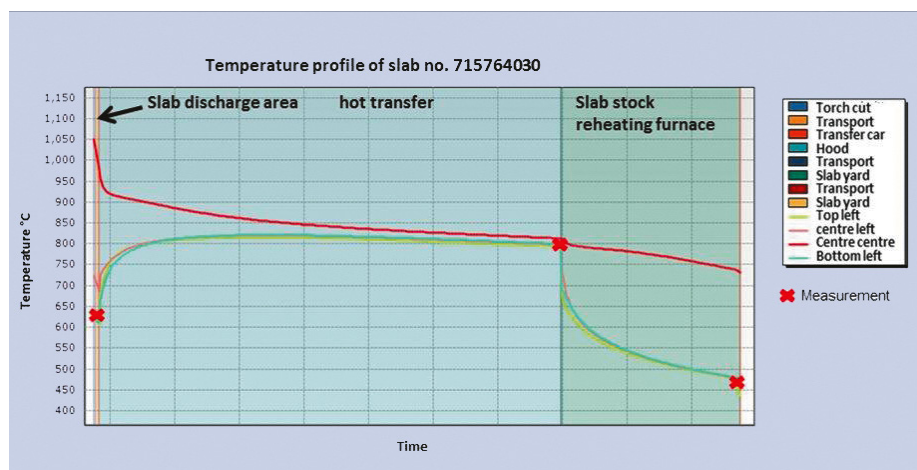


Figure 5. Simulated versus measured slab temperatures from the torch cut to the reheating furnace; green – surface, red – core (Picture: SMS group)

- cooling of the slab surface until ferrite transformation of the surface is complete.

This may, for example, be performed by controlled cooling in a water cooling section.

Water cooling. In pile cooling practice, the slabs are piled with the core temperatures being approx. 980°C. The slabs need approx. 150 h to cool down to 80°C. This time depends on the slab's position within a pile. The cooling time can be shortened by cooling in a water basin. To this purpose, the slabs first cool down to 400°C core temperature in the pile for 30 h, before they are placed in a water basin. Only after one hour in the water basin, the target discharge temperature of 80°C will be reached.

Other applications include:

- Determination of the longest possible residence time of the slabs until hot grinding. In order to avoid cracks caused by the grinding process, grinding has to be performed at temperatures above the material-specific temperature at which martensite transformation sets on.
- In case of retarded cooling, it is possible to determine the times it takes slabs covered by heat retention hoods or slabs placed in pits to reach their target temperatures, or to simulate the slab temperatures given a defined residence time.
- Determination of the shortest necessary residence time until completion of the $\gamma \rightarrow \alpha$ transformation. This is to maximize the capacity of the existing slab storage area by accelerated cooling

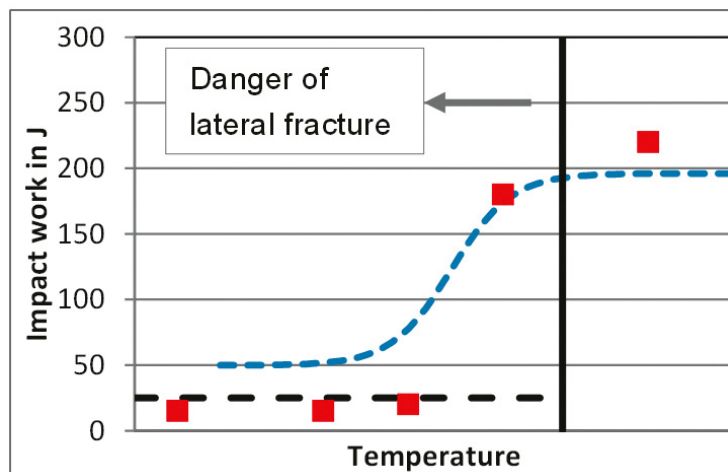


Figure 6a. Schematic plot of the change in impact work with changing temperatures for steel 1.4520 (Picture: SMS group)

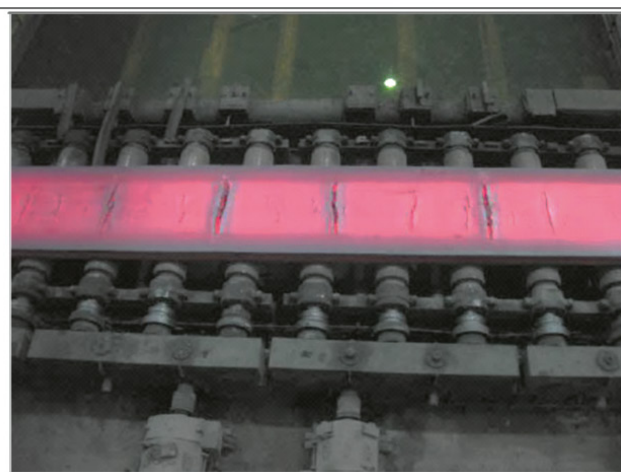


Figure 6b. Transfer bar in the roughing mill showing lateral fracture. The slabs were charged at room temperature (Picture: SMS group)

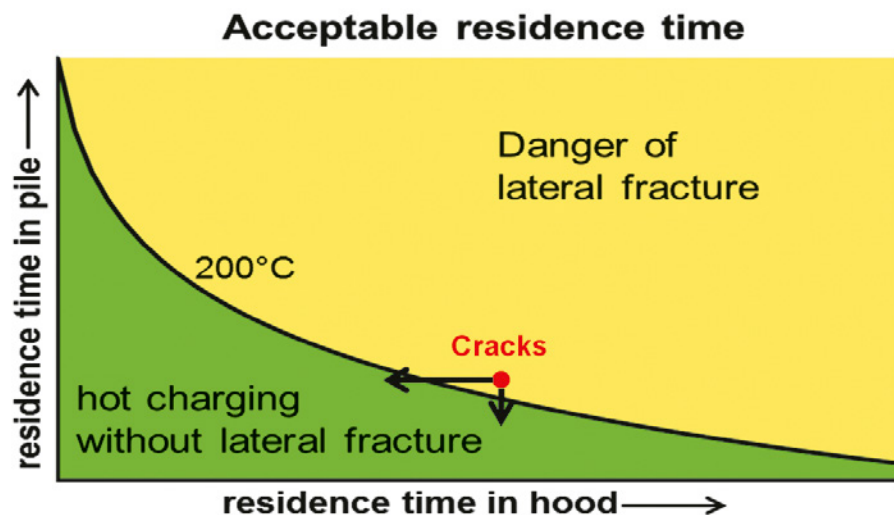


Figure 7. Longest possible times a slab may rest in a pile after a given residence time under a hood without running the risk that the slab temperature falls below the minimum acceptable temperature at which it may still be charged into the reheating furnace (Picture: SMS group)

of slabs after completion of the phase transformation.

- Identification of the causes leading to slabs being damaged in the slab preparation area or during subsequent cooling.

Material model. Temperature field calculations require the knowledge of the steels' thermos-physical properties. The data about these properties is provided by a materials model integrated in the STT model. This materials model calculates the enthalpy, thermal conductivity and density for carbon, low and high-alloy steels based on the chemical composition of the respective steel grade.

An additional materials model is provided for assessing the susceptibility to cracking based on displayed TTT curves. All the materials models take into account in their calculations the chemical composition of the respective steel grade and contain ductility curves for the evaluation of the temperature curves.

Variant "Process"

The objective of this model is to monitor online the temperature control of the slabs leaving the caster along their way through the slab preparation and storage areas, during the hot transfer and, if applicable, during forced cooling. The temperature curves are calculated in real time, taking into account the available process tracking data of the slab posi-

tions and the respective residence times. STT monitors the process by the following means:

- simultaneous simulation of the temperatures of all slabs in the slab storage area,
- cross-sectional 2D temperature field calculation at half-length of the slab,
- graphical visualization of the slabs' changing position during the transport,
- graphical visualization of the slab temperature curves,
- database storage of the process route and of the calculated temperatures for each slab,
- issuing of alert messages when critical target temperatures or residence times critical for the downstream slab transport are being approached.

The HMI displays the slabs as they are being hot charged on a transfer car covered with a hood. The temperatures are known at all times. Any effects on the temperature distribution within the slabs caused by unforeseeable delays are visible immediately. The thus calculated temperatures may be used in connection with a warehouse management system to optimize the process control (for example, by defining the times until a slab is ready for hot grinding or hot charging). For purposes of documentation and quality control, the simulated slab temperatures and those measured at specified positions are stored as time-stamped data in a data system. The measured slab temperatures are compared with the initial temperature profile of

the slab. The results of this comparison are used as input information for the simulation subsequently performed by STT "Process".

Variant "Replay"

This variant allows processes that have already been completed to be replayed. The objective of this function is to support quality engineers in identifying the origins of irregular features found on the slabs.

The replay function simulates, in retrospect, processes that have already been finished. These simulations help operators analyze the reasons for irregularities occurring in the process. In so doing, the replay feature uses the process data stored in the data base. It simulates faster than real time, checking whether temperature control was able to keep the slab temperatures within the specified ranges and quantifying any deviating temperatures. The alarm messages stored whenever irregularities have occurred make it easy to focus on potentially critical slabs.

Conclusions

The STT (Slab Temperature Tracking) model developed by SMS group simulates slab temperatures during hot transfer from the continuous caster to the reheating furnace in the hot rolling mill. The model affords the flexibility to combine any cooling processes (in piles, pits, heat retention hoods, water basins, etc.) and simulates them in real time as a multi-body system. The model makes the overall process of hot slab transport safer and more predictable - a key step towards the digitalized steel-works.

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Hot rolling

NLMK updates reheating furnace at its hot-rolling mill in Lipetsk, Russia

NLMK has started installation of the reheating furnace equipment in its hot-rolling mill at the Lipetsk site in Russia. A new walking-beam furnace will replace a previous-generation pusher-type furnace.

The new furnace will add 110,000 t per year (+2%) to the hot-rolling mill's output, improve product quality thanks to a more sophisticated technology for charging slabs into the rolling mill, reduce energy consumption by 50% and cut this section's emissions by half. Investment in the project will total 4.4 billion Rubel (approx. 61 million Euro). The production capacity of the new furnace is 320 t per hour (2.25 million t per year).

Sergey Filatov, managing director, NLMK, said: "The construction of the reheating furnace is one of the key projects of our group's investment programme. The equipment upgrade is aimed, among other things, at the development of the sales portfolio through product quality improvement. The start-up of the unit will not only increase NLMK's rolled products output, but also enable a complete transition to a high-performance, resource-saving technology intended for heating slabs before rolling".

The furnace update is a brownfield project, that is being implemented while the

"The start-up of the new furnace will not only increase NLMK's rolled products output, but also enable a complete transition to a high-performance, resource-saving technology intended for heating slabs before rolling."

Sergey Filatov, managing director, NLMK

hot-rolling mill is operational without any capacity reduction. The construction began in July 2018. At present, foundation work has already been completed at the construction site, slab transport mechanisms have been installed, and the furnace shell is now being installed. It is planned to complete the upgrade in September 2019 and bring the unit into operation as early as in October.

Throughout 2004 – 2011 new generation furnaces were installed at the hot-rolling mill. This new furnace will be the fourth in a row; with its launch, the last obsolete reheating furnace will be decommissioned.

For the first time in NLMK Group, the full cycle of BIM (building information modeling) technology was used for the furnace design and the organization of construction and assembly works. This technology enabled the company to create a digital twin of the future unit and, already at the design stage, mimic the construction process, eliminate possible errors in advance and optimize the volumes and schedule of construction works.

■ NLMK



One of the new walking beam furnaces installed previously (Picture: NLMK)

Digitization of quality management processes

Digital system Eyeron receives award at the “Industry of the Future” forum in Moscow

At the French-Russian forum on future cooperation Fives’ real-time steel quality control solution, Eyeron, was awarded in recognition of its successful implementation at the Severstal steelmaking plant and rolling mills.

The French-Russian “Industry of the Future” forum, which was held for the first time in Moscow on 11 April 2019, was jointly organized by the French Alliance “Industrie du Futur”, the technological centre of the French-Russian Chamber of Commerce “Nauka Innov”, the Russian Union of Industrialists and Entrepreneurs, Russian Ministry of Industry, the Embassy of France to Russia, with support from MEDEF International and Fives. During the one-day event, representatives of businesses and ministries, academics and technical experts shared their vision of the industry of the future, as well as technological and industrial cooperation. At the forum Fives was represented by a strong delegation, headed by Frédéric Sanchez, Fives’ chairman and CEO, who is also chairman of MEDEF International.

A major focus was placed on the potential of the digital economy, technologies, additive technologies, automation, robotics, big data and IoT. The system Eyeron, a real-time quality management software tool, was successfully implemented at Severstal, a leading Russian steelmaker. Since 2018 Severstal has been using Eyeron in the steel shop, the hot strip mill 2000 and the plate rolling shop No. 2. It enables the shops to automatically manage more than 20,000 rules to make decisions on product quality.

“This is the first intellectual system to automatically certify product quality in the metallurgical industry of the Russian Federation, and it’s the first system in the world which not only makes the decision on certification, but also offers possibilities to rework slabs and rolled products, considering the quality required by our clients. The system has a very high potential, and we plan to introduce it into other production shops of the plant,” said Alexander Shevelov, chief executive officer (CEO) of Severstal.

“The system allowed us to significantly reduce non-conforming products. The quantity of slabs requiring scarfing was also decreased.”

Peter Mishnev, Quality director of Severstal Russian Steel division



Severstal’s and Fives’ teams receive the award in the presence of Oleg Bocharov, Deputy Minister of Industry and Trade of the Russian Federation (Picture: Fives Group)

Peter Mishnev, Technical Development and Quality director of Severstal Russian Steel division, added: “Following the results of last year, the system allowed us to significantly reduce non-conforming products. The quantity of slabs requiring scarfing was also decreased. The financial benefit totaled € 1.7 million.”

“It is in Fives’ DNA to develop innovative solutions for and together with its clients. Eyeron, a breakthrough digital application for steel quality management, was implemented at the Cherepovets plant

thanks to the forward-thinking and spirit of partnership between the teams of Severstal and Fives,” said Frédéric Sanchez during the ceremony. Recognizing these significant achievements, the award was presented by Oleg Bocharov, Deputy Minister of Industry and Trade of the Russian Federation in the presence of Sylvie Bermann, French Ambassador to Russia.

| Fives Group

Strip processing lines

Pickling line-tandem cold mill optimized at Hyundai Steel in just a few weeks

After a short refurbishment, all performance tests were successfully completed. The capacity of the pickling line-tandem cold mill has been increased to feed an additional galvanizing line. Prior analysis enabled the targeted modernization with reduced investment.

Primetals Technologies optimized the drive and automation equipment of the pickling line-tandem cold mill (PLTCM) No. 1 at the Dangjin plant of Hyundai Steel, a Korean steel producer, within a short period of time. After a refurbishment phase at the end of 2018, all the agreed proofs of performance for the production of more than 20 different product groups were completed by January in a period of just four weeks. The production capacity of the PLTCM was substantially increased at the same time, which now enables it to supply cold-rolled strip to an additional strip galvanizing line at the Suncheon plant. The refurbishment was preceded by a detailed analysis of the weak points of the entire plant and the development of a targeted refurbishment concept. This increased the production potential of the existing lines and minimized the investments needed for new equipment.

The analysis preceding the refurbishment showed that, instead of replacing the entire drive train, only the drive trains on stands two and three had to be replaced to eliminate the weak points. The available installed reserves of stands one, four and five were utilized and the load optimally redistributed to achieve the required increase in throughput for the complete plant. New transformers and cycloconverters were installed on stands two and three, and new motor and gear units were mounted on the existing foundations.

The "Motor Utilization Model – MUM" newly developed by Primetals Technologies was used for the first time to make the maximum possible use of the installed performance reserves of the new and existing stand motors. The load was distributed optimally to adapt it specifically to the product mix and to obtain the best possible dynamic use of the forming forces of

the individual stands. The objective was to achieve the maximum degree of forming along the complete line, and to come as near as possible to the load limits of the individual stands.

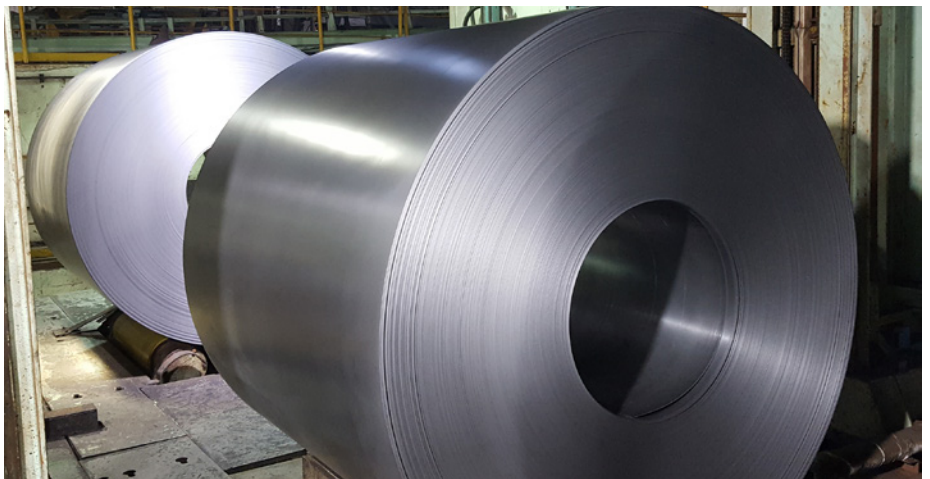
The continuous power of the new machines is around 36 percent higher and they allow the rolling work to be optimally redistributed in the tandem mill. Some of the low-voltage drives were also replaced. For example, the rollers on the infeed side are now equipped with motors and drives that are up to 50 percent larger in order to deliver the required pulling force at higher speeds. In addition to the renewal of the drive equipment, the technological controls in the basic automation and the Level 2 rolling regulations were modernized. The refurbishment of all parts of the plant was planned in great detail and completed right on schedule within the timeframe of 15 days. It was even possible to hold the first tests of the rolling operation one day earlier than scheduled. The first strip was successfully rolled as planned on December

14, and the plant was brought up to its previous throughput within three days.

All the verifications for more than 20 individual product groups – mainly interstitial free grades and other products for the automotive sector – were completed by the end of the first month. The plant also significantly surpassed the contractually agreed parameters within the first few weeks.

PLTCM no.1 at Hyundai's Dangjin site now has a capacity of around 1.8 million t per year. It processes cold steel strip in widths ranging from 600 to 1,800 millimeters. The entry thicknesses can vary between 1.2 and 6 millimeter, and from 0.25 to 3 millimeters on the exit side. The maximum strip speed is 1,400 meters per minute. The line consists of four four-high stands and one six-high rolling stand. Primetals Technologies had equipped the line with process automation back in 2006.

■ *Primetals Technologies*



First coils produced at Korean steel producer Hyundai Steel's Dangjin plant after the pickling line-tandem cold mill (PLTCM) no. 1 had been restarted (Figure: Primetals Technologies)

Automatic control of a continuous pickling line

Gauge for crossbow measurement optimizes leveling

In continuous pickling line No. 2 of Salzgitter Flachstahl GmbH, laser gauges measure the crossbow of the strip at both the entry and exit of the pickling section. The measured data is used to optimize the performance of the upstream stretch-leveler.

In the No. 2 continuous pickling line of Salzgitter Flachstahl GmbH, a stretch-leveler arranged upstream of the pickling section levels the strip and removes adhering scale from the strip surface. An important function of the leveling process is to minimize the crossbow of the strip so that for the downstream processing stages the strips are as flat as possible.

The stretch-leveler is adjusted based on a setting chart. This chart gives the roll nest setting for different mechanical strip parameters and dimensions.

The pickling line processes strips between 800 and 1,920 mm wide, and 1.5 and 6 mm thick. The maximum entry

speed into the pickling line is 265 m/min, the maximum recoiling speed at the exit is 500 m/min. The setting values given in the chart used to be determined empirically in tests with different strip grades and based on an assessment of the existing crossbow. Consequently, the values in the chart used to be exclusively based on results derived from "snapshots". Special cases, for example, strip featuring parameters not included in the chart, were not recognized or could not be responded to in an appropriate manner.

Additionally, entering the values was a very cumbersome and optimizing the leveler setting a lengthy procedure. In order to

be able to achieve leveling results that would come up to requirements under all circumstances, i.e. also in case of varying strip parameters, the team at Salzgitter was looking for a solution that would be able to take into account in a reproducible way all parameters relevant for the leveling process – including parameters for new, higher-strength grades – and make the setting chart a reliable control tool for the leveling process.

Key information for the leveler and downstream processes

The idea was to introduce a process that would continuously measure the crossbow of all strips ahead of the pickling section, use the obtained measurement results to optimize the existing setting chart and, in a second step, to use them to automate the roller setting process.

The crossbow was to be measured not only before but also after pickling by a second gauge arranged at the line exit. This was to fulfill two purposes: First, it would document the product quality and, second, it would make it possible to transmit the measured data to downstream processes, such as the tandem mill, in order to inform the operators about incidents such as difficult-to-thread strips.

The application at the Salzgitter pickling line required a solution that would provide a high level of measuring accuracy and be easy to integrate into the existing environment. These requirements suggested the installation of optics-based measuring systems. For reasons of space, the only feasible position for the entry gauge to be



The entry gauge is arranged between the bridle rolls and the entry of the pickling section (Picture: Salzgitter Flachstahl)

Christian Belde, Engineer Operations, Continuous Pickling Line 2, Salzgitter Flachstahl GmbH, Salzgitter, Germany;
Dr. Patrick Overath, Senior Software Application Engineer, nokra GmbH, Baesweiler near Aachen, Germany

arranged downstream of the leveler was between an existing bridle roll set and the pickling section entry.

There the strip runs at about nine meters above the shop floor. The gauge was to be of a compact design that would provide the operators a maximum of safety during maintenance activities. Another restriction to be considered in the design was that the bay crane posed a limit to the clearance above the strip.

It was also important that the gauge would be easily dismantled in case personnel performing maintenance or repairs would need to access the inspection door of the entry strip accumulator situated below the gauge.

The solution: the laser-light-section method

When the project team at Salzgitter was looking for a suitable supplier, their attention fell upon nokra. The measuring specialists based in the town of Baesweiler near Aachen, Germany, proposed laser-light-section systems equipped with two cameras for both measuring positions.

nokra suggested a measuring frame low enough to not interfere with the crane movements and optical equipment arranged at a safe distance from the strip surface, ruling out any risk of mechanical damage. The optics of the transmitter and receiver units was to be installed at about 1,900 mm above the passline. This layout made the nokra system more suitable for the application on hand than solutions using either a single camera that would have to be arranged higher above the strip or solutions using several cameras that would have to be installed at a very short distance from the strip surface.

The nokra system captures a measuring range of up to 500 mm above the passline. The uncertainty of the height measurement is ± 0.3 mm. With about 3,200 pixels across the up to 1,920 mm wide strips, the system has a transverse resolution of 0.6 mm.

These were not the only factors relevant for Salzgitter's decision: easy integration into the existing environment, project management performance and, of course, the costs were other important aspects.

nokra's media system provides distinct cost advantages over competitor systems as it requires no compressed air and no water cooling. This has a positive effect on



The exit gauge documents the crossbow of the pickled strip (Picture: Salzgitter Flachstahl)

both capital and operating costs. An encapsulated housing protects the optical equipment from dust, spray water and heat. Narrow-band filters in the receiver optics prevent the system from being influenced by extraneous light.

Already during the tendering phase, nokra adopted a highly flexible approach to the system's electrical integration. The project team at Salzgitter had planned to provide part of the infrastructure, for example the switch boxes, themselves in order to match them to the standard installations within the works. As nokra had provided detailed descriptions of the interfaces as early as during the tendering phase, the supply ranges of all the project partners involved could be defined at a very early stage.

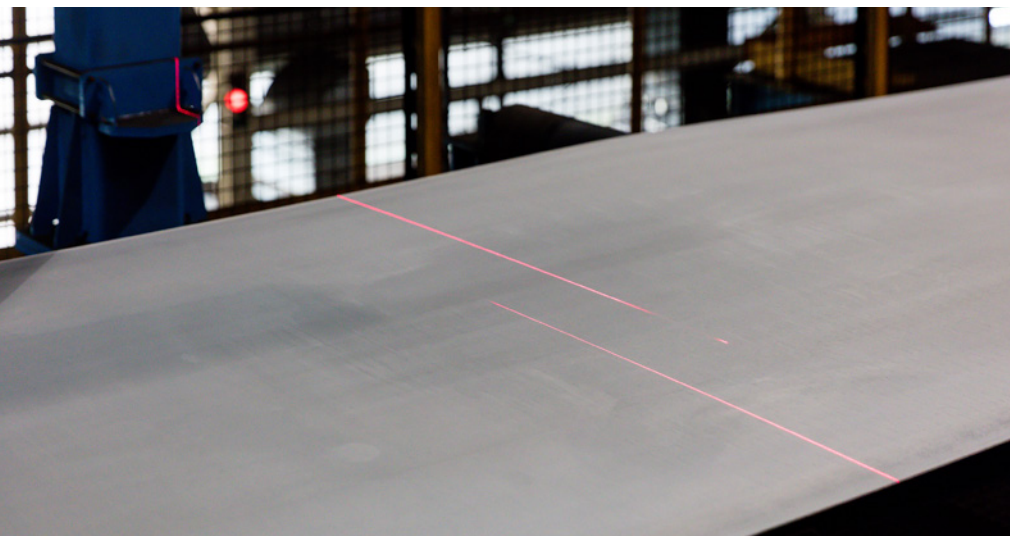
Salzgitter eventually decided in favor of nokra for reasons such as the ease of integrating the mechanical and electrical equipment, nokra's profound expertise gained from the design and installation of optical systems for the metallurgical industry and the low project costs resulting from these advantages.

After the successful preliminary acceptance testing in nokra's workshops in Baesweiler, the system was shipped to the customer according to schedule. The installation at Salzgitter was completed in no more than two shifts during a scheduled line stoppage, as basically all needed to be done on site was to set up the measuring frame on the prepared foundations and connect the cables.

The technology in detail

In light-section measurements, a laser arranged at 90° above the strip projects a laser line onto the strip surface. A camera installed at an inclined angle above the strip in a sensing unit captures this projected line. When there is no crossbow, the camera "sees" a straight line. When the surface is curved, the camera captures a curved line from which the height of each surface point of the line can be calculated.

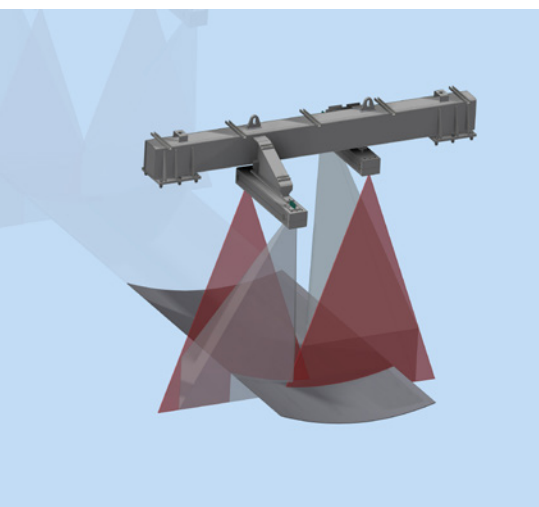
The No. 2 continuous pickling line at Salzgitter processes strip of up to 1,920 mm width. To cover the full strip width, two laser-camera systems have been installed in this case, with each camera capturing about one strip half. Through this solution, the required transverse resolution is achieved. The two laser lines are projected across the running strip at slightly offset positions in order to avoid cross-talk between the two cameras. This offset is compensated by the system software.



The two laser lines projected across the running strip are offset in order to avoid cross-talk between the two channels (Picture: Salzgitter Flachstahl)

As the design of the interfaces had been agreed in great detail long before the scheduled delivery, the project team at Salzgitter had been able to complete ahead of the delivery not only the programming for integrating the new gauge into the process control system but also the testing of the electrical systems and the interfaces. Thus the gauge could become operational immediately upon completion of the installation work.

As in the nokra system the laser source and the camera are firmly connected to each other within a common housing, all needed to be done during commissioning



In light-section measurements, a laser arranged at 90° above the strip projects a laser line onto the strip surface. A camera installed at an inclined angle above the strip in a sensing unit captures this projected line (Picture: nokra)

was to check the factory calibration with a ruler.

First experience

The entry gauge measures the crossbow of the strip right after the stretch-leveler. Each strip is measured along its complete length. The measured data is displayed and stored, and forms the basis for optimizing the roller setting chart for the stretch-leveler. The exit gauge documents the crossbow of the pickled strip. This gauge is needed because on its way from the pickling tank to the recoiler the strip is subjected to various deflections and deformations all of which may change the original leveling result and have an effect on the flatness. Such a comprehensive documentation is particularly important for strips that after pickling are directly shipped to an external end customer. But also for internal "customers" like the tandem mill, the data is very useful as the operators can be informed in advance about the arrival of strip featuring a pronounced crossbow.

The data provided by the second gauge can also be used to further refine the setting chart for the stretch-leveler, as the data measured at the pickling entry can be complemented by the measurements taken from the strip as it leaves the pickling section.

The measured data is displayed to the operating staff on the control pulpit, and transferred to the existing level 2 system and to the group-wide level 3 quality system. The nokra engineers can access the

system from the headquarters in Baesweiler via remote support.

The installed systems have fulfilled the objective of optimizing the leveling process: The roller setting chart no longer relies on random samples only, but is refined by data sets from all strips processed in the line. What's more, the new system has made it much easier and less time-consuming to add new values to the chart and keep it up to date, also with a view to the behavior of new grades. The result is strip of good flatness for the downstream processes, such as the tandem mill or the galvanizing and organic coating lines.

The system has been running stably since the completion of the commissioning phase. There have been no unscheduled stops and the system has proved that it works reliably even without the use of compressed air and water-based cooling. The encapsulated measuring beam shielded by an additional protective housing has been performing as expected under the ambient conditions of the pickling line. The only service activity required is to clean the glass panes from time to time.

Keys to the success of the project were the exact interfacing details which nokra was able to provide as early as during the tendering phase and the great deal of flexibility that the company demonstrated in integrating the system into the existing plant environment. Another essential aspect was that nokra could bring to bear profound experience from a great many installations of optical measuring systems in the iron and steel industry. Consequently, the planning and commissioning effort for the project team was very low.

The project team's future plans are to use the data measured by the entry gauge as input for the inline control of the stretch-leveler and stop using the roller setting chart.

Another conceivable option is to use the crossbow measurements also to optimize upstream processes, such as hot rolling, e.g. by analyzing in which way cooling and coiling processes promote the formation of crossbow. A first step to this end is to superimpose the topographic data captured at the pickling line entry with the heat maps from the wide hot strip mill in order to analyze, for example, the impact of the cooling curves on the occurrence of crossbow.

| nokra GmbH

Case study

Need more speed: an application of the welding carriage that increases performance

Aumayr GmbH, Austria, specializes in custom-made ventilation pipe systems. With its high-quality work, the family-run company has been involved in a number of prestigious projects, such as Europe's most modern music theater in Linz. For a large ongoing project, Aumayr manufactured around 1000 running meters of ventilation pipe components – an impressive quantity produced by means of the ArcRover 22 from Fronius.

Aumayr is one of Austria's most renowned manufacturers of ventilation pipe systems and has approximately 300 employees working at three locations in Austria and the Czech Republic. The family-run company, founded in Linz in 1965, has a lot of top-class equipment for metalworking, featuring computer-controlled laser cutting and stamping machines, servo-electric bending machines, and other high-tech systems. Its machine park, together with its in-house design and development department, enable the company to develop and

"Investing in the ArcRover 22 was absolutely the right decision"

Erwin Kunst, Head of Metalworking at Aumayr GmbH

produce custom-made products from scratch.

This innovative metalworking approach means that Aumayr can manufacture ventilation pipes that conventional ventilation manufacturers would struggle to produce. At the start of 2018, the company received a large order for welded stainless-steel

ventilation pipes. Even as the order was being calculated, it became clear that new alternatives to the previously manual welding process would be required due to the hundreds of running meters of weld seam and the customer's stringent quality demands. Above all, sheet metal thicknesses up to four millimeters had to be



Aumayr welded around one thousand running meters of ventilation pipe components. This picture shows the as-yet unheated and unfinished components (Picture: Fronius)

welded without warping and in consistently high quality to create ventilation pipe components that were sometimes as long as six meters, as high as 2.5 meters, and as wide as 1.5 meters.

Mechanization, quality, and cost effectiveness

The key aims when the ventilation components were being manufactured were to have a mechanized welding process, achieve perfect weld-seam quality in all components, and optimize costs by eliminating the need for reworking and working at a higher welding speed.

To meet these criteria, Aumayr decided to purchase a Fronius welding carriage: the sturdy, flexible ArcRover 22. "The compact design of the welding carriage and its compatibility with the Fronius TPS 5000 CMT and TPS/i 500 welding systems we already had in our fleet were the primary reasons for choosing it. We've now been using the ArcRover 22 since March 2018. Our welders particularly like the durability and ease of use of the welding carriage," explains Erwin Kunst, Head of Metalworking at Aumayr. He continues, "Even during the initial tests, we were able to achieve improved and, most importantly, consistent weld-seam quality at a higher welding speed. The carriage is also easy to mount and always stays on the track thanks to its guide rails."

Achieving perfection by combining processes

The welding experts opted for a pulse process with an average amperage of 300 amperes in order to achieve optimal root formation when welding the approximately four-millimeter thick side walls of the ventilation components. This approach ensures the necessary heat input. The somewhat "cooler" Fronius CMT (Cold Metal Transfer) mixed process – unbeatable in terms of welding quality – was used for section welding the flange plates and bracing ribs in longitudinal and transverse directions. The mixed process adjusts the ratio of hot pulse process cycles to cool CMT process phases as required for the specific application, resulting in perfectly welded, virtually spatter-free metal connections with zero distortion.

"The constant speed of the welding carriage combined with the right welding



The ArcRover 22 welding carriage with guide rails welds a longitudinal seam (Picture: Fronius)



Welders love the ArcRover 22 from Fronius primarily because of its impressive durability and ease of use (Picture: Fronius)

processes were the key factors in achieving the consistently reproducible high quality of the weld seams," explains Erwin Kunst. "It ultimately vastly exceeded our expectations. The Fronius welding experts deserve a special thank you for their advice and support right from the start. Together we were able to signifi-

cantly optimize the welding quality as well as the production times. Investing in the ArcRover 22 was absolutely the right decision."

Fronius International GmbH,
Pettenbach, Austria

Machining of narrow strip edges

Laser-assisted online inspection of the strip edges reveals minor contour deviations

The new ConScan® system by hpl-Neugnadenfelder Maschinenfabrik visualises the edge contour shape of narrow strips, thus allowing the operator to intervene immediately in the production process in case of minor deviations from the specified contour.

When machining the edges of narrow strips as for example after a slitting process, the shape of the strip edges is an essential part for many applications. On the one hand, no cutting burrs should arise; on the other hand, special applications require the strict observance of specified radii and the position of their vertices.

Experienced operators recognise by the flow of chips generated during the machining process if the edge contour corresponds to the specifications. This, however, includes a very high subjective influence. The machined edge contour can be assessed more objectively if a sample is cut at the end of the coil which is then examined, for example, under a transmitted light microscope. This method is very accurate but has the disadvantage of examining the edge shape only after a complete coil has been machined.

Since the requirements regarding the exact shape of the strip contours has been

continually increased, hpl-Neugnadenfelder had been asked by many of its customers to find a solution for a precise online measurement of strip edge contours. This has resulted in the development of ConScan®, a laser-based system for the visualization of strip edge contours.

It displays in real-time the contour of all strip edges graphically on a screen. The system visualizes typical defects, as for example burrs, edge chippings as well as radii and edges that are out of alignment. Tests show that even the smallest deviations such as minor edge chippings can be displayed clearly in full detail.

This allows the operator to adjust the chip removal during the running production: the quantity of produced high-quality strips increases, production downtimes are avoided.

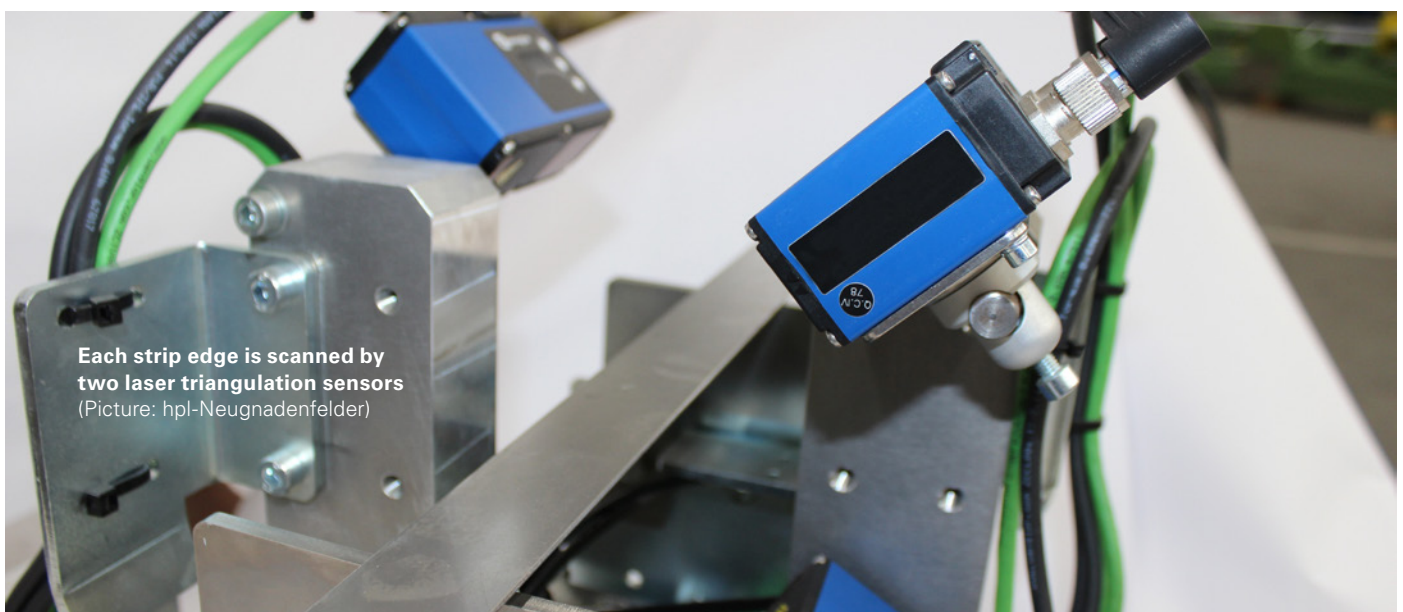
The system displays deviations from the specified edge contour of approximately one-hundredth of a millimetre. In a further development stage, the deviations

are to be measured and the measured values directly incorporated into the control of the knife positions.

ConScan® is equipped with two laser sensors on each strip side. They project lines on the target edge which are detected by cameras mounted at a tilted angle. Their resolution is a few µm. Based on the course of the projected lines, the strip edge is calculated by the software and displayed on a screen.

hpl-Neugnadenfelder has developed ConScan® for strips having, for example, just been cut in a slitting line and featuring strip widths ranging from 2 to 200 mm and strip thicknesses from 0.3 to 4 mm. Because of being only about 300 mm long in direction of the strip, the system can also be retrofitted into existing edge trimming lines

hpl-Neugnadenfelder Maschinenfabrik GmbH, Ringe, Germany



Each strip edge is scanned by two laser triangulation sensors
(Picture: hpl-Neugnadenfelder)

Long steel products

Special structural steel for the construction machinery industry

Machines for the construction industry are used under the most challenging conditions. For complex construction work on difficult subsoil, solid and durable equipment is required. thyssenkrupp Schulte, a company of the group's Materials Services Business Area, has proven to be a reliable dependable partner for these extreme requirements.

One longstanding customer of thyssenkrupp Materials Services is BAUER Maschinen GmbH, a leader in the development and manufacture of special foundation engineering equipment. The company designs and builds large rotary drilling rigs, cable excavators, diaphragm wall milling machines, cutters and grab systems, and vibrating equipment as well as all the necessary tools. Their foundation engineering parts such as the masts of the drilling rigs and booms of the cranes, use special structural steel.

Every year, thyssenkrupp Schulte delivers around 350 metric tons of special structural steel to this customer just-in-time and tailored to requirements.

Outstanding properties

The decisive factor in the selection of the material is its properties. "We ensure that our partners receive only the finest material. Special structural steel is particularly remarkable for its wear resistance, which makes the equipment extremely resilient and tough," says Christoph Hartmann, Regional Coordinator for Special Structural Steel at thyssenkrupp Schulte in Munich.

A further factor in the choice of material is its strength which allows the wall thickness of the parts and components to be reduced while at the same time providing high load-bearing capacity. This is an important criterion for the mobility of vehicles weighing several tons each.

"Special structural steel is particularly remarkable for its wear resistance, which makes the equipment extremely resilient and tough"

Christoph Hartmann, Regional Coordinator at thyssenkrupp Schulte



thyssenkrupp Material Services operates a global distribution network and offers tailored supply chain management (Picture: thyssenkrupp)

Around 90 percent of the material is from the XAR® family and the high-strength N-A-XTRA® fine-grained structural steel produced by thyssenkrupp Steel Europe. In total, thyssenkrupp Schulte supplies its customers with around 50,000 tons of special structural steel yearly.

thyssenkrupp Schulte GmbH is the materials partner for steel, stainless steel and nonferrous metals. The company pro-

vides tailor-made services for more than 70,000 customers from industry, trade and construction. The basis for this is a wide range of flat products, sections and tubes for all requirements and tailored to the individual wishes of customers. Another decisive competitive advantage is customer proximity. With over 40 locations, thyssenkrupp Schulte is always close to its customers and can deliver quickly and reliably anywhere in Germany. The diverse product range, competent technical advice and comprehensive services round off the portfolio of Germany's largest materials dealer.

thyssenkrupp Materials Services

Residential construction

“Lilla Integralen” building with distinct façade made from colour coated steel

The eye-catching “Lilla Integralen” features a façade made from GreenCoat colour coated steel, from SSAB, and has been named a finalist for the esteemed Swedish architectural award Plåtpriset 2019.

SSAB continues to strengthen its position among innovative architects that create award-winning buildings. Recently, renowned Sandellsandberg Arkitekter decided to use sustainable GreenCoat® steel for the highly unique “Lilla Integralen” apartment building in the newly constructed residential district of Vallastaden in Linköping, Sweden. The first phase of the housing project in Vallastaden resulted in 1000 homes being built by 40 different architects.

“Lilla Integralen” is an elegant semi-detached house with four apartments on three floors and a roof terrace. The distinctive shape of the building utilizes a sinusoidal profiled façade made from premium GreenCoat® colour coated steel to ensure sustainability and durability in harsh weather as well as high aesthetics. The Metallic Silver colour was chosen to create beautiful light reflections in the relatively densely populated neighborhood of Vallastaden. “Since we see sustainability from a long-term perspective, we try to find a good balance between the environment and social responsibility in architecture. When we draw a house, it will last for many generations to come, and that of course places demands on the material we use. Using GreenCoat® steel, which offers both durability and environmental benefits, felt obvious,” explains Thomas Sandell, the architect at Sandellsandberg Arkitekter.

In addition to high performance and aesthetics, most GreenCoat® products feature a Bio-based Technology (BT) coating with Swedish rapeseed oil instead of fossil based oils, which are traditionally used. This patented coating technology is currently the only one of its kind on the market.

The building process went smoothly with GreenCoat® being commended for its ability to be adapted to the great number of details that the design of “Lilla Integralen” required.

“Since we see sustainability from a long-term perspective, we try to find a good balance between the environment and social responsibility in architecture”

Thomas Sandell, Sandellsandberg Arkitekter

“Lilla Integralen” is one of five buildings nominated for the Swedish Plåtpriset 2019 award, which aims to encourage and pay tribute to innovative and sustainable buildings, where the properties and expressions of the metals are utilized in a successful architectural design. PLÅT19 is an exclusive architecture event that focuses on the possibilities of metal in the architec-

ture and the sustainable community building. As in previous years, PLÅT19 presented some of the world’s foremost architects, material experts, researchers and facade innovators who showed the possibilities of the metal facades.

SSAB



The elegant, yet playful “Lilla Integralen” was inspired by old industrial buildings. It was nominated for the Swedish architectural award Plåtpriset 2019 (Picture: SSAB)

Heinrich Georg and HIT enter into a strategic cooperation

Autonomous low-floor transport vehicles for the intralogistical transport of heavy loads

Heinrich Georg GmbH Maschinenfabrik and Hafen- und Industrietechnik GmbH (HIT) including its sister company HIT Machine Technology GmbH have signed a cooperation agreement with respect to the use of autonomous low-floor transport vehicles in connection with machine tools and plants from Heinrich Georg.

In steel and aluminium strip production or in the manufacture of cores or magnetic yokes for transformers, the transport of material and product to and from the various production stages ties up resources and may delay processes. A similar situation we find in the mechanical engineering sector: when machining large and heavy parts and components, such as aluminium slabs or turbine rotors, unproductive waiting times often occur as a result of transport means being needed for other tasks.

The cooperation with HIT now enables Heinrich Georg Maschinenfabrik to offer a solution following the trend of digitalization and the growing interlinking of production processes. The autonomously operating move-e-star low-floor transport vehicles from HIT are designed to automatically transport loads of between 2 t and 120 t weight, for example, coils or stacks of transformer plates, within production areas. They slide underneath the load-carrying racks, pick them up and navigate autonomously to their destination where they set the load down again.

Driverless transport systems orientate themselves in their surroundings

The vehicles' central elements are the drive axles which integrate the traction drive, the steering system and the lifting system. They give the move-e-star excellent maneuverability. The vehicles can freely move about the floor: they can drive forwards and backwards, sideways or at an angle, and even turn "on a table". Thus, the vehicle can easily and safely perform transport tasks even in tight spaces and



Bernd Peter Schmidt (left), Managing Director of the Transformer Lines Division and Director of GEORG, and Andreas Thölke, Managing Director of HIT Machine Technology GmbH (Picture: Heinrich GEORG Maschinenfabrik)



The 20-t-payload move-e-star is extremely flat thanks to its eight low-slung axles and its Vulkollan wheels.
(Picture: HIT Hafen- und Industrietechnik GmbH)

aisles. It handles thresholds and gradients with ease as it comes with a dynamic leveling system.

Andreas Thölke, Managing Director of HIT Machine Technology GmbH, explains how the autonomous navigation of the transport platforms works: "The system orientates itself within the production area by means of laser scanners. It creates a map of the current situation and determines the optimal route. We call this "natural navigation", as the transport platforms need no rails or wiring in the floor. Moreover, they are not very demanding in terms of levelness of the floor."

Under the cooperation agreement, HIT will supply the vehicles, the automation technology and the interfaces to connect to the plant operator's control system, which issues the transport orders and receives the "complete" messages.

According to Bernd Peter Schmidt, Managing Director of the Transformer Lines Division at Heinrich Georg, autonomous transport provides a number of significant advantages: "At our customers' facilities cranes usually have to perform a whole lot of different tasks and they are often used at their maximum capacity. The low-floor transport vehicles provide a great deal of flexibility because they oper-

ate autonomously and, being optimally controlled by a dedicated software, they do not tie up any other transport equipment. Additionally, they can be easily retrofitted in existing production facilities as they do not require any physical alterations, such as the installation of guiding rails, etc."

The new transport platforms move-e-star can be easily integrated into digitalized production environments, further paving the way for Industry 4.0.

■ *Heinrich Georg GmbH Maschinenfabrik, Kreuztal, Germany*

Liebherr orders high-strength steel plate for new heavy-duty mobile cranes

NLMK Clabecq, Belgium, is going to supply high-strength Quend 1100 steel for the telescopic booms of Liebherr's new type of mobile cranes.

Liebherr's new crane type will be designed for a load capacity of 230 t. The prototype was recently exhibited at the international trade fair for construction and mining machinery, bauma 2019.

High-strength Quend plates are designed for use in the construction of bulk vehicle frames, bulk lifting and handling machinery, vehicle trailers, and other machinery where high structural strength is of the essence. The use of Quend plates reduces the weight of structural components by more than 20%, thus reducing the cost of production and increasing the performance of the machines. In 2018

high-strength Quend 960 and Quend 1100 grades (minimum tensile strength 960 MPa and 1,100 MPa, respectively) were tested for compliance by lifting equipment manufacturers Liebherr, Manitowoc Cranes and Tadano Faun GmbH.

■ *NLMK, Liebherr*

Updated IoT analytics include streaming analytics and machine learning capabilities

Ulbrich Stainless Steel uses AI-embedded solution to flatten its big data challenges

Staying ahead of maintenance and production challenges that keep precision metals rolling out of its plants on time is a high priority for Ulbrich Stainless Steel & Specialty Metals. That's why the global company recently chose SAS® Analytics for IoT to analyze the data created by its plant sensors.

Ulbrich Stainless Steel manufactures the metals used in a wide range of specialty products from engine parts to the wire used in stringed musical instruments. "Precision and quality are key factors in manufacturing highly engineered metals that support our customers' varied needs," said Jay Cei, Chief Operating Officer at Ulbrich. "Collecting machine and sensor data from our factories and integrating that with ERP system data will help us understand the intricate relationships between equipment, people, suppliers and customers. Using SAS to learn what our IoT data means is critical for understanding how we can become more productive and efficient in the future."

"Streaming analytics will not only help Ulbrich understand what is happening now with their machines, but it will also enable them to predict future events, such as when a machine needs maintenance before it breaks down," said DJ Penix, President of Pinnacle Solutions, a SAS implementation partner.

Faster results for all users with streamlined SAS Analytics for IoT

Recent upgrades to SAS® Analytics for IoT mean enterprises have access to the latest suite of AI, machine learning and streaming analytics available.

The software provides a simplified way for any user to prepare stationary and streaming IoT data for analysis without



Ulbrich Stainless Steel uses SAS analytics to help it understand the IoT data streaming from its connected factories (Picture: Ulbrich Stainless Steel & Specialty Metals Inc.)

specialized skills. Whether a data scientist, business manager, or someone in between, they can use SAS Analytics for IoT to quickly select, launch, transform and operationalize IoT data to make informed, timely decisions.

The upgraded SAS software provides open application program interfaces (APIs) to enable integration with other SAS, third-party and open-source products.

"SAS talks about 'democratizing analytics' as the ethos behind SAS Analytics for

IoT," said Marta Muñoz Méndez-Villamil in a recent IDC Market Note. "This comes as a welcome message to a technology that seems to be stuck at precisely this stage. Tools and solutions that help simplify analytics, insights visualization, and actioning of IoT data accelerate enterprises' time to value from their IoT implementations."

Jason Mann, Vice President of IoT at SAS, said companies can no longer afford to ignore the hidden signals in their IoT data. "To thrive, organizations need a solution that addresses data complexity and automates timely and accurate decision making. SAS Analytics for IoT delivers this capability across the entire analytics life cycle – from data preparation to discovery to scalable deployment."

Mike Guilfoyle, Director of Research at ARC Advisory Group, said there's a gulf

"Tools and solutions that help simplify analytics, insights visualization, and actioning of IoT data accelerate enterprises' time to value from their IoT implementations."

Marta Muñoz Méndez-Villamil, Research Director, IDC EMEA

between companies undertaking analytics-driven digital transformation and those successfully scaling their efforts. "This is due in large part to the underlying complexity of Industrial Internet of Things (IIoT) ecosystems and the many business needs related to them," he said. "To be successful with IIoT, an organization needs an analytics solution that can support a diversity of needs, including myriad use cases, disparate user requirements, agnostic interoperability with systems and sources, the capacity to manage data at rest and in motion, and a breadth of analytics methods."

SAS will showcase SAS Analytics for IoT and its embedded AI capabilities via connected patient, connected quality, and connected equipment demonstrations at SAS Global Forum, the world's largest analytics conference, April 28 through May 1 in Dallas. To learn more about the convergence of AI and IoT, download The Artificial Intelligence of Things white paper.

Ulbrich joins a growing group of enterprises which depend on SAS Analytics to

solve IoT challenges whether crafting precision metal parts, enhancing the satisfaction and productivity of patient-clinician interactions, optimizing the retail customer experience, or building cutting-edge aircraft.

Lockheed Martin makes herculean strides with SAS Analytics for IoT

Lockheed Martin's Hercules C-130 aircraft has been in production and operation for 65 years and has been continually reinvented to meet changing customer needs. Today, C-130s are operated out of 70 nations around the world. The four-engine turboprop started as a troop transport in the 1950s, but has evolved to support upwards of 100 different mission requirements in its lifetime. Its many mission capabilities include flying into hurricanes to collect weather data, landing on short and/or austere runways to deliver relief supplies, aerial firefighting, air-to-air refueling, long-range search and rescue, global peacekeeping, special operations and sup-

porting critical military operations around the world.

To keep this aerial platform evolving, Lockheed Martin has turned to SAS, another proven platform that has been continually reinvented to meet new customer needs and requirements.

With AI and advanced IoT analytics from SAS, Lockheed Martin and its customers analyze data streaming from sensors on each aircraft to predict maintenance and repair needs, and ensure the Hercules can continue to lift, fly and deliver.

"When you understand the probability of parts failure, everything changes in the way you manage and operate your fleet," said Duane Szalwinski, senior manager with Lockheed Martin's sustainment organization. "With SAS, we're developing fleet-wide practices that demand a positive culture shift for us and our customers."

| SAS Institute Inc., Cary, N.C./USA

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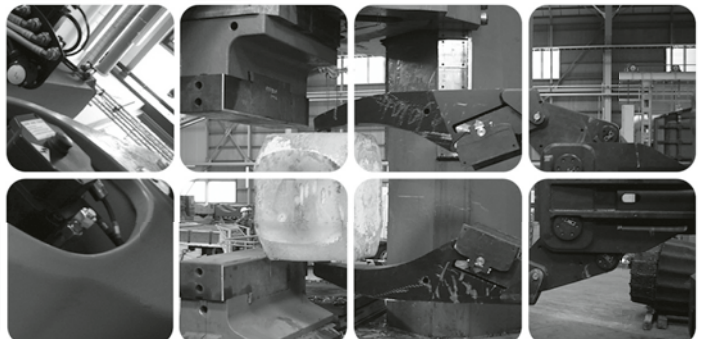
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330 tonnes of beams from Belval

Sections and merchant bars contributes to sustainable transport in Norway

Borregaard, a Norwegian biochemicals producer is currently building a new warehouse that will allow them to store all the lignin in one place instead of different sites, thus improving logistics and reducing CO₂ emissions from road transport. The warehouse is being built with beams from ArcelorMittal Europe – Long Products.

Borregaard and logistics company Borg Havn are building a modern, sustainable lignin warehouse in Øra, near Fredrikstad in Norway. The structure of this new 19,000 square metre warehouse is currently being built with 330 tonnes of beams produced by ArcelorMittal Europe – Long Products Sections and Merchant Bars' mill in Belval, Luxembourg.

The new warehouse will bring many benefits:

- optimise product flow and improve logistics,
- strengthen the position of the port.

Today, Borregaard stores lignin at a number of different sites, several of which are outside the company's premises. Lignin is currently transported via Borregaard's own port facility or by road to Borg Havn for delivery to customers. A new warehouse to store all the lignin will therefore mean more efficient logistics with fewer stages of transportation.

"This project will reduce CO₂ emissions from road transport and relieve traffic growth on European roads. It will also greatly reduce the local heavy transport related to Borregaard's exports from Borg Havn"

Per A. Sørlie, CEO of Borregaard

"Increased volumes will allow for transport to more European destinations, which will also benefit other users of the port. In this way, sea transport will increase and heavy road traffic will decrease," says Tore Lundestad, Port Director of Borg.

The building is also designed for future energy-saving solutions such as roof-mounted solar cells.

Zero-emissions solutions

Borregaard is keen to have efficient zero-emissions solutions for the trans-

portation of raw materials to its production facilities and products to its customers. In addition to a joint pilot project to study possible autonomous transport solutions by ship across the River Glomma between Sarpsborg and Fredrikstad, Borregaard is also looking into the future potential for road transport using electric vehicles.

"This project will reduce CO₂ emissions from road transport and relieve traffic growth on European roads. It will also greatly reduce the local heavy transport related to Borregaard's exports from Borg



Structure of a modern, sustainable lignin warehouse (Figure: Henning Klausen, Metacon)



The warehouse will be completed by the end of 2019 (Figure: Henning Klausen, Metacon)

Havn,” says Per A. Sørli, CEO of Borregaard.

Borregaard’s plant in Sarpsborg has an annual lignin capacity of 160,000 tonnes, and an increasing proportion is speciality products. A centralised warehouse at Borg is part of a project where Borregaard is investing NOK 500 million in upgrading and specialisation of the Sarpsborg plants producing lignin products. The project also involves enhanced drying capacity, new ideas for the storage of liquid materials and improved solutions for logistics, infrastructure and energy.

Steligence®, a radical and disruptive construction industry concept

ArcelorMittal has unveiled in June 2018 a radical new concept for the use of steel in construction, which will facilitate the next generation of high-performance buildings and construction techniques and create a more sustainable life-cycle for buildings. Known as Steligence®, the concept revolves around the idea of buildings as holistic entities where all aspects of design are considered in an integrated way, as part of the whole. As such, it proposes the

need for better dialogue between various specialist architectural and engineering disciplines, recognizing not only specialist expertise, but also the need for enhanced co-operation between experts. Steligence® further suggests that the use of best available technology in steelmaking, as well as modularization of steel components in buildings where possible, has the capacity to generate efficiency gains in the design, construction and configurability of buildings as compared to those using traditional construction methods.

Additionally, because steel is infinitely recyclable, Steligence® sets the stage for architects to consider the life-cycle, recyclability and, ultimately, re-usability of a building and its components at the earliest point in the design process.

This new approach to construction from ArcelorMittal has been brought about by real advances in technology which now make steel an even more attractive material for construction than was previously the case. As such, the Steligence® concept has the potential to drive significant architectural and sustainability benefits.

These benefits include more building storeys within a given height than is the case with traditional building systems and

materials; less deep and therefore less costly foundations due to the lower weight of steel buildings compared with traditional materials; and far longer uninterrupted spans between columns, resulting in much better flexibility of interior floor layout.

In addition, buildings designed using the Steligence® philosophy will be easier to assemble (and potentially disassemble) and therefore quicker to build, leading to significant efficiencies and cost savings for the construction sector.

While steel’s infinite recyclability potential is clearly superior to that of alternative materials, even then there are associated costs given the energy necessary to melt and re-form. In this context, design where possible using modular steel components can enable re-use rather than re-cycling of steel components in new buildings at the end of life of the original building. This ‘re-use’ possibility gives steel a huge advantage over traditional building materials, particularly as regulations strengthen regarding the sustainability credentials of buildings.

Steel already plays a big role in the circular economy. Steligence® will enable the construction industry and buildings themselves to play an even more significant role in it. “As climate, energy and resource scarcity intensifies, win-win solutions like Steligence® become imperative for business and society at large. Buildings play a huge part in all our lives, so creating a construction concept that improves their social, economic and environmental impact while dramatically enhancing their functionality and aesthetics has been a huge but important challenge”, says Greg Ludkovsky, ArcelorMittal’s global head of research and development.

“Steligence® is the culmination of several years’ intensive scientific, independent peer reviewed research to develop specific-use steel for the construction industry. By combining this R&D with extensive consultation of leading players in the construction industry, we have landed on a radical new approach to construction which is underpinned by a clear philosophy: to build a sustainable business around a sustainable construction industry that delivers for future generations.”

About Borregaard

Borregaard owns one of the world’s most advanced and sustainable biorefineries. By using natural, sustainable raw materials, Borregaard produces advanced and eco-friendly biochemicals that can replace oil-based products. Borregaard has 1,010 employees in factories and sales offices in 16 countries in Europe, America, Asia and Africa. Borregaard also has strong positions in ingredients and fine chemicals.

| ArcelorMittal, Luxembourg

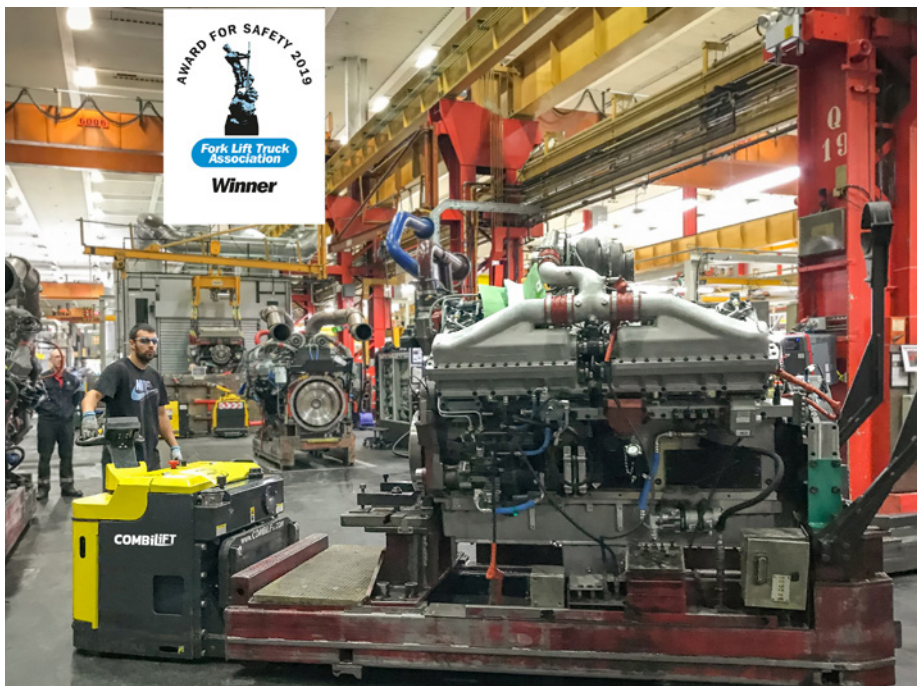
Combilift wins safety award

The Combi-PPT powered pallet truck has won the Safety Category of the British Fork Lift Truck Association (FLTA) Awards for Excellence 2019.

The Combi-PPT is a high performance pedestrian operated powered pallet truck, the first model of which was designed following a very specific request from a Com-

bilift customer wanting to enhance operational safety and material flow in its manufacturing facilities. This proved to be so successful that the Combi-PPT was put into serial production last year and models with capacities from 3,000 kg up to 16,000 kg are now available.

According to the FLTA, the jury was impressed by the truck's large capacity and its potential to replace counterbalance trucks, improving safety in pedestrian areas. Its design and features such as AC powered drive, steer and lifting technology enable very large and bulky products to be manoeuvred with ease in confined spaces without the use of a ride-on forklift. Above all, it can also do this whilst ensuring maximum safety when working in areas where other personnel may be present, in busy production plants for example, thanks to Combilift's unique, patented multi-position tiller arm. This incorporates tiller and operator offset position with the touch of a button and enables excellent visibility from the side of the truck, also reducing any crush risk to the operator when working in tight spaces.



Award-winning heavy-duty forklift truck (Picture: Combilift)

Combilift

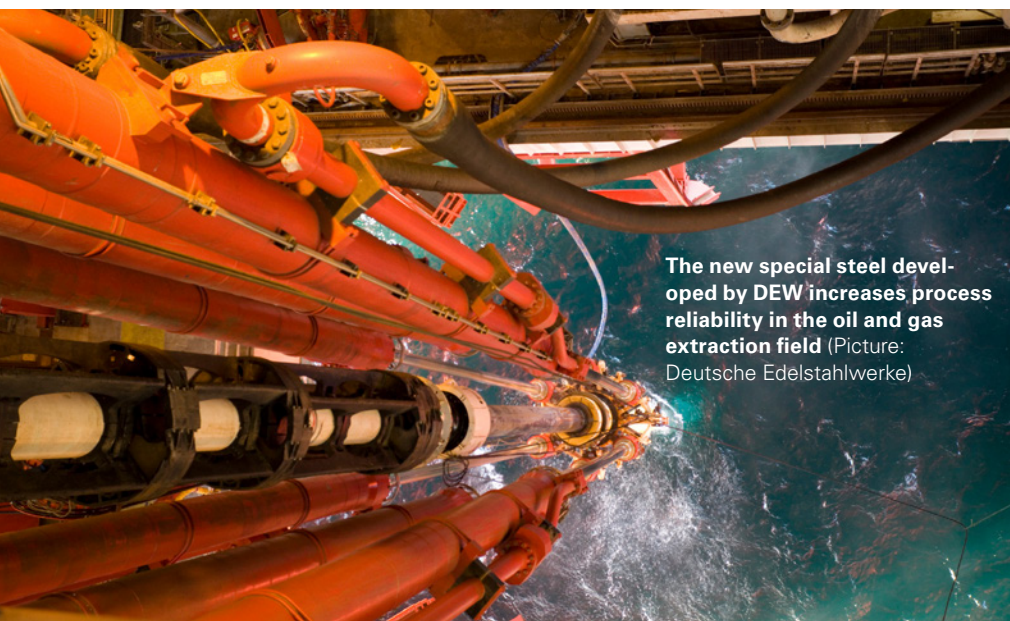
DEW develops new high-strength steel

The new special steel, Corrodur 4418 Mod, developed by Deutsche Edelstahlwerke (DEW), a company of the Schmolz + Bickenbach Group, is characterized by high strength, outstanding toughness and very good resistance to pitting and stress corrosion.

With a tensile strength of at least 862 MPa, a yield strength of 758 MPa and a toughness of at least 81 J at -10°C, Corrodur 4418 Mod, also known as Super 13Cr, is far superior to conventional 13% chrome steels. The very good resistance to pitting and stress corrosion is a noteworthy attrib-

ute. What is more, the steel's high strength opens up greater scope to users when it comes to dimensioning components and planned increases in performance with unchanged dimensions.

With this steel grade, DEW was one of the first steel manufacturers to be qualified by the leading oil and gas company, Statoil ASA (since 2018: Equinor ASA) according to NORSOK M650 for a strength level of minimum 110 ksi yield strength. Corrosive media, such as acid gases or chloride, constantly attack the materials-handling technology at high temperatures in the oil and gas extraction sector. Corrodur 4418 Mod takes over where conventional chrome steels reach their limits and offers users an extremely high-performance material solution. DEW presented the new steel at the recent NACE International Corrosion Conference & Expo in Nashville, USA.



The new special steel developed by DEW increases process reliability in the oil and gas extraction field (Picture: Deutsche Edelstahlwerke)

Deutsche Edelstahlwerke (DEW)

Rentel offshore wind farm based on thermomechanically rolled heavy plate

Steel from the Saarland is helping Belgium achieve its climate targets. The largest turbines installed so far in the Belgian North Sea stand firmly on 55,000 t of thermomechanically rolled heavy plate produced by Dillinger.

The plate is used to form the monopile foundations of 42 wind turbines and of the farm's electrical substation. They are installed at water depths of 22 to 36 m. The wind farm covers an area of 22.72 km². With a total installed capacity of 309

MW, Rentel can supply around 285,000 Belgian households with green electricity.

| Dillinger

Konecranes and Demag operate under new name

Both companies will from now on operate under one name: Konecranes and Demag Private Limited.

This name change follows acquisition of the Material Handling & Port Solutions (MHPS) segment from Terex Corporation by Konecranes PLC in 2016. The acquisition led to some of the leading

global brands such as Demag, Gottwald and Noell being added to Konecranes' product portfolio. In India, Konecranes and Demag are now geared to offer products which can be used across industries like general engineering, steel, power, automotive, paper to name a few. The company has a state-of-art 48,000 m² manufacturing facility and patented

techniques and capacity of manufacturing more than 1,000 cranes per year, with exports to the Middle East, Australia and Asia.

**| Konecranes,
Demag**

SCT 2020 – 6th International Conference on Steels in Cars and Trucks

The sixth edition of the international conference and exhibition on Steels in Cars and Trucks will be staged in Milano from 14 – 18 June 2020.

During the five-day conference future trends in steel development, processing technology and applications will be discussed under the motto "Bringing

the automotive, supplier and steel industries together". Papers presented will cover topics like steel components in cars and trucks, manufacturing components, new steels, modelling, simulations and testing. Specially featured will be the initiative Lightweight Forging and cooperation in R&D. The conference is organized by TEMA Technol-

ogie Marketing, with advisory support by Steel Institute VDEh, which established this conference series in 2005. ArcelorMittal is the main sponsor of the event.

**| TEMA Technologie Marketing,
Steel Institute VDEh**

World record bridge building project in the Emirates

SSAB's S500MC steel was used as the basic material from which the corrugated plates were made to build a bridge in Ras Al Khaimah.

Opened to traffic in March this year, the bridge can withstand a load of 2,000 vehicles per hour and was completed in half the time it would have taken to build a similar bridge made of concrete. It is also estimated that the bridge will last more than a 100 years and require less maintenance than other bridges accommodating heavy traffic. The steel arch structures comprise corrugated iron sheets that are installed in line with pre-approved designs and project requirements. The bridge span, meas-

uring 32.39 m, has already earned a place in the Guinness World Records book as "the largest metal buried bridge span"

Shammal Bridge is part of the UAE government's Phase 2 expansion of Emirates Road project to link Rak with the rest of the UAE. The bridge is located within the "mega" Rak Ring Road that was also recently completed.

ViaCon in Poland produced the corrugated steel plates used to build the bridge.

| SSAB

The new steel structure bridge in the UAE
(Picture: SSAB)



Steel processing in combination with engineering services

SSAB enhances steel processing services for customers in Central and Eastern Europe

SSAB is providing new processing opportunities for customers to explore, with a laser cutting machine and top-class press brake. The new machines were presented during a unique event at the SSAB steel service centre in Oborniki, Poland.

Around 130 manufacturing executives and representatives from SSAB, including SSAB CEO Martin Lindqvist, met at the SSAB Shape steel service centre in Oborniki, Poland in March. After inspirational seminars and a plant tour, they were given an exclusive demonstration of the new laser cutting machine and press brake that began operations in Q4 of 2018.

"Many of our excellent and long-term customers have developed fantastic products and continue to drive innovation, and they expect us to follow suit. In order for SSAB to serve our customers with both capacity and capability, we have decided to invest in new machines. There is clear market demand and this will support our customers in their future developments as well," says Jonas Gozzi, Head of Shape Projects.

The new press brake has a maximum press power of 2000t, which makes it optimal for forming thicker materials up to 12.2 meters in length, and powerful control systems enabling high accuracy on the final product's tolerance. It also features a patent pending technology that allows for the forming of completely unique parts with

an extremely narrow radius. A control system in the press enables energy saving of up to 90% that of a conventional machine, reducing the environmental footprint of the production process.

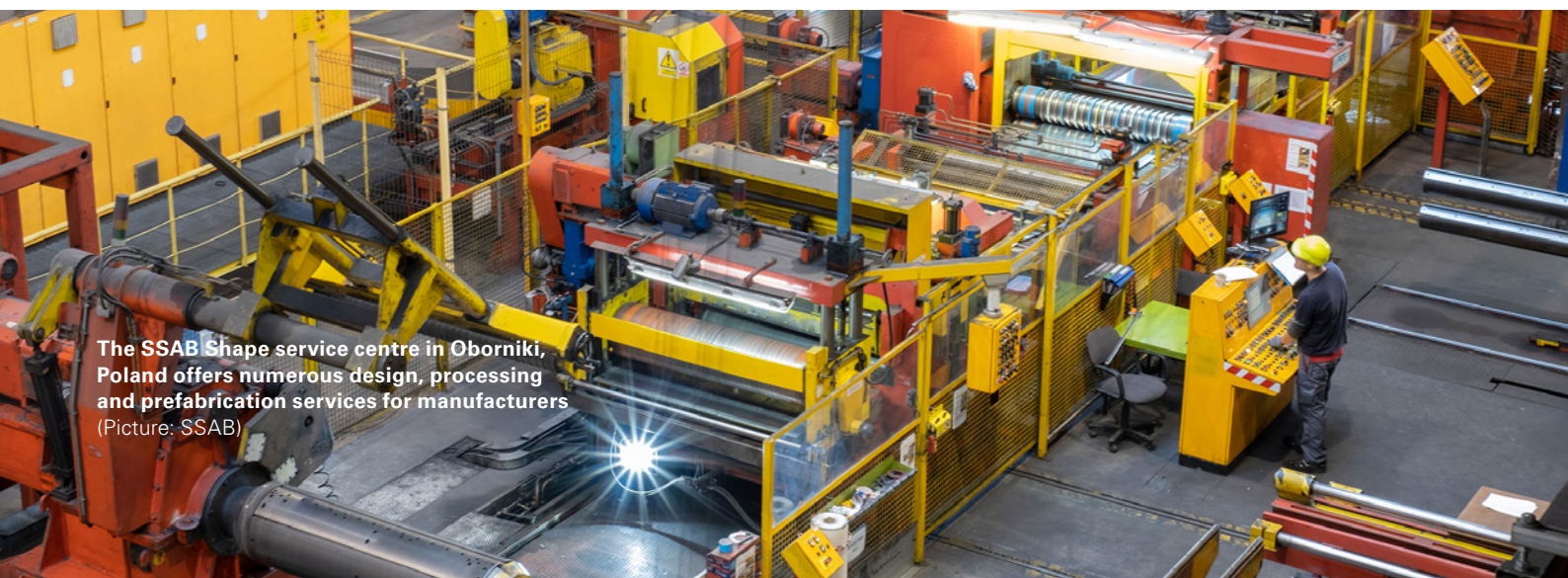
"The combination of SSAB's high-strength steels, such as Strenx and Har-dox, and the press brake has allowed for completely new possibilities for lighter, stronger and more sustainable products. The combination of the new, patent pending forming technique and the machine's CNC control system enable us to deliver high accuracy details in a stable process. Every delivery will fit right in, reducing assembly time for our customers," explains Tobias Svensson, Managing Director of SSAB Poland.

The laser-cutting machine nicely complements our plasma and flame cutting capabilities. It is a more suitable choice for cutting thinner dimensions of advanced high-strength steel allowing for narrow tolerances and high-quality edges. "The laser cutting machine fills a gap in the market for large-size, high-quality details. Our machine fits right in with a flexible 3D head, a powerful 6 kW laser source and a table of 14 m x 4.1 m," says Svensson.

The SSAB Shape service centre in Oborniki, Poland offers numerous design, processing and prefabrication services for manufacturers looking to create new and innovative products, reduce assembly times and utilize the full benefits of the steel grade chosen. The new investments in machinery will benefit customers that share SSAB's drive for innovation, uniqueness, and a more sustainable world. Those looking for engineering and product solutions can contact SSAB Services for more information and assistance.

Driven by customer demand, SSAB continues to invest in creating a more complex diverse range of services. The latest addition in machinery will allow SSAB to serve customers with a wider range of products and create new possibilities for innovative solutions. Allowing SSAB to perform steel processing in combination with engineering services will enable customers to speed up the development and time to market of their products.

SSAB AB, Stockholm, Sweden



The SSAB Shape service centre in Oborniki, Poland offers numerous design, processing and prefabrication services for manufacturers (Picture: SSAB)

Negative price effects and a slowdown in demand

Klöckner & Co reports lower earnings in first quarter of 2019 despite higher sales figures

Operating income (EBITDA) has significantly decreased to €34 million compared to €56 million in Q1 2018. However, sales are up by 4.6% to €1.7 billion (Q1 2018: €1.6 billion). Also, sales via digital channels increase further to 27% (Q1 2018: 19%).

Klöckner & Co reports price-driven sales growth of 4.6% to €1.7 billion in the first quarter of 2019. Operating income (EBITDA), at €34 million, was below the €56 million recorded in the first quarter of 2018. While Klöckner & Co benefited from a very positive price environment in the first quarter of the prior year, earnings in the first three months of fiscal year 2019 were impacted by negative price effects. Demand was also down, primarily due to the weakness of the European automotive sector. Compared with net income of €21 million in the prior-year quarter, the net loss amounted to €10 million. As a result, earnings per share were €-0.10 (Q1 2018: €0.21).

Digitalization of the supply and value chain as well as expansion of the XOM Materials independent industry platform are core components of the "Klöckner & Co 2022" strategy. The proportion of sales generated through digital channels further increased to 27% in the first quarter of 2019 (Q1 2018: 19%). XOM Materials likewise continued its dynamic growth, with 17 contracted distributors and 230 customers on the platform in April 2019. Additionally, XOM Materials was launched in the USA in the first quarter of 2019. The Group's digital unit, kloeckner.i, began providing consulting services to external companies during the reporting period. An initial consulting project with a DAX 30 company is already being implemented.

In light of negative price effects and a slowdown in demand – notably in the automotive business – Klöckner & Co expects to generate operating income (EBITDA) of €50 million to €60 million in the second quarter and full-year EBITDA of €180 million to €200 million before significant non-recurring items. With regard to EBITDA after significant non-recurring items, the aforementioned negative impact will be mainly compensated by the sale of one site in the United Kingdom with an expected gain of more than €30 million.

"Negative price and volume effects dominate earnings development in 2019"

Gisbert Rühl, Chairman of the Management Board, Klöckner & Co SE

Growth in sales and operating income yet in fiscal 2018

Klöckner & Co's sales went up 7.9% to €6.8 billion in fiscal year 2018, largely on account of the higher price level. Operating income (EBITDA) improved by 3.4% to €227 million. Aside from the positive trend in prices over much of the year, this increase was primarily a result of optimization measures. Net income was €69 million, compared with a prior-year figure of €102 million boosted by one-off tax effects. Earnings per share consequently stood at €0.68 (2017: €1.01).

For its key markets of Europe and the USA, Klöckner & Co mostly expects to see slight growth in real steel demand and corresponding growth in Group shipments for 2019. Sales, on the other hand, are anticipated to rise sharply on the back of investment made in expansion and an expected higher overall steel price level than in the preceding year.

Klöckner & Co is one of the largest producer-independent distributors of steel and metal products and one of the leading steel service companies worldwide. Based on its distribution and service network of around 160 locations in 13 countries, Klöckner & Co supplies more than 100,000 customers. Currently, the Group has around 8,500 employees.

As a pioneer of change in the steel industry, Klöckner & Co is in the process of digitalizing its entire supply and value chain. In addition, its digital unit, kloeckner.i., is increasingly providing consulting services for external business clients. XOM Materials, an independent venture launched by the

Klöckner & Co Group, is geared to develop into the leading industry platform for steel, metal and related products. As a pioneer of the digital transformation in the steel industry, Klöckner & Co's target is to fully digitalize its supply and service chain as well as to expand the independent open industry platform XOM Materials to become the dominant vertical platform for the steel and metal industry and its neighboring industries.

kloeckner.i and diva-e join forces in the field of digital strategy

kloeckner.i, the digital unit of Klöckner & Co, and diva-e, leading Transactional Experience Partner for digital business, have intensified their cooperation and will now offer their consulting services jointly. Christian Dyck, CEO of kloeckner.i, explains: "On the back of successfully digitalizing Klöckner & Co, we began offering digital consulting services to external companies at the start of the year. To do this, we cooperate with selected premium partners such as diva-e to ensure we are able to offer our customers a top-quality, end-to-end consulting and implementation package." Sirko Schneppe, Managing Director and CSO diva-e Platforms, says: "Pooling our consulting and solutions portfolio is the logical next step in our longstanding successful collaboration. Both partners are passionate not only about developing theoretical digital concepts, but also implementing actual digital projects with quantifiable economic benefits."

| Klöckner & Co SE, Duisburg, Germany

Coil storage and dispatch

Tata Steel unveils fully sustainable storage facility for coils in IJmuiden, NL

Air-curtains to prevent heat loss, automated loading bays and energy-recovering cranes are just some of the innovations housed in Tata Steel's new steel coil storage facility in IJmuiden, the Netherlands, designed to be the most sustainable yet. The official opening of the new, ultra-modern storage facility for steel coils took place on Wednesday 8 May.

The so-called LA Hall enables the steel company to optimise logistics processes and further improve deliveries to customers while at the same time being energy neutral. The new 10,000 square metre facility has a capacity of 50,000 t of steel coils and is strategically located, close to the company's galvanising lines, where the steel is coated with a layer of zinc as protection against corrosion.

"The new storage warehouse enables us to serve customers even better and to

organise the processes on our site even more efficiently," says Hans van den Berg,

"This new building, which is entirely constructed from steel and clad with our own steel panels, is a textbook example of how you can construct an extremely functional and fully sustainable building with steel"

Hans van den Berg, director of Tata Steel in IJmuiden, NL

director of Tata Steel in IJmuiden. "It is also important that this new building, which is entirely constructed from steel and clad with our own steel panels, is a textbook example of how you can construct an extremely functional and fully sustainable building with steel," says van den Berg.

In the new storage warehouse, the very latest technologies have been applied in the field of security and computer technology. The fully automatically controlled LA Hall is twice as large as the other storage facilities on the Tata Steel site in IJmuiden. The building is energy neutral and has been designed in such a way that the residual heat from the cooling water from the nearby hot strip mill is used to heat it. The cranes in the warehouse are equipped with a system which stores the energy generated when a load is lowered, which can then be used to lift the load. The warehouse is also well insulated.

Tata Steel is one of Europe's leading steel producers, with steelmaking in the Netherlands and the UK, and manufacturing plants across Europe. The company supplies high-quality steel products to the most demanding markets, including construction and infrastructure, automotive, packaging and engineering.



The new 10,000 square metre facility has a capacity of 50,000 tonnes of steel coils and is strategically located, close to the company's galvanising lines (Picture: Tata Steel Europe)

| Tata Steel Europe

worldsteel short range outlook April 2019

Global steel demand continues to grow in slowing economic environment

The World Steel Association (worldsteel) forecasts global steel demand will reach 1,735 Mt in 2019, an increase of 1.3% over 2018. In 2020, demand is projected to grow by 1.0% to reach 1,752 Mt. worldsteel released its short range outlook in April 2019.

Commenting on the outlook, Mr Al Remeithi, Chairman of the worldsteel Economics Committee said, "In 2019 and 2020, global steel demand is expected to continue to grow, but growth rates will moderate in tandem with a slowing global economy. Uncertainty over the trade environment and volatility in the financial markets have not yet subsided and could pose downside risks to this forecast."

In 2018, global steel demand increased by 2.1% (after adjusting for China induction furnace closures – see note in October 2018 short range outlook), growing slight-

ly slower than in 2017. In 2019 and 2020 growth is still expected, but in a less favourable economic environment. China's deceleration, a slowing global economy, and uncertainty surrounding trade policies and the political situation in many regions suggest a possible moderation in business confidence and investment.

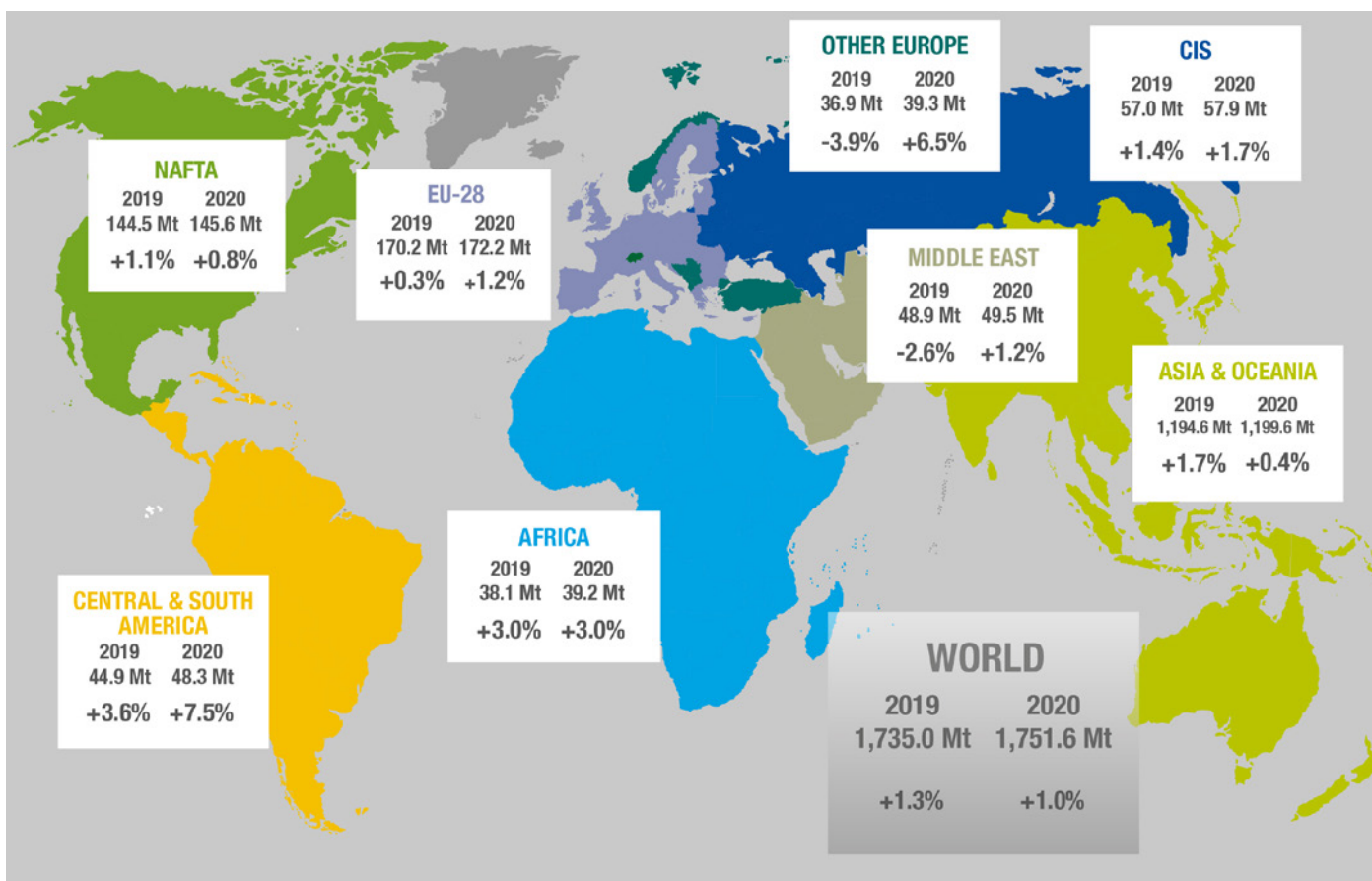
Chinese steel demand still robust

Steel demand in China continues to decelerate as the combined effect of economic rebalancing and trade tension is leading to slowing investment and sluggish manufac-

turing performance. Mild government stimulus cushioned the economic slowdown in 2018. In 2019, the government is likely to heighten the level of stimulus, which is expected to boost steel demand. In 2020, a minor contraction in Chinese steel demand is forecasted as the stimulus effects are expected to subside.

Weaker world trade environment

Steel demand in the developed economies grew by 1.8% in 2018 following a resilient 3.1% growth in 2017. We expect demand to further decelerate to 0.3% in 2019 and



Demand for finished steel; Mt = million t; y-o-y growth rate (Picture: worldsteel)

0.7% in 2020, reflecting a deteriorating trade environment.

In 2017-18, steel demand in the US benefitted from the strong growth of the economy driven by government-led fiscal stimulus, leading to high confidence and a robust job market. In 2019, the US growth pattern is expected to slow with the waning effect of fiscal stimulus and a monetary policy normalisation. Therefore, both construction and manufacturing growth is expected to moderate. Investment in oil and gas exploration is expected to decelerate as well, while a boost in infrastructure spending is not expected.

The EU economies also face the deteriorating trade environment and uncertainty over Brexit. We expect slower growth in demand for steel in the major EU economies (especially in those more export dependent) in 2019. Steel demand growth is expected to improve in 2020, dependent on a reduction in trade tensions.

Japan recorded growth in steel demand in 2018, supported by a favourable investment environment and continued con-

struction activities as well as a boost in consumer spending prior to the consumption tax increase. In 2019 and 2020, steel demand is likely to contract slightly due to a moderation of construction activities and decelerating exports despite the support provided by public projects.

Having overcome the shocks of demonetisation and the Goods & Services Tax (GST) implementation, the Indian economy is now expected to achieve faster growth starting in the second half of 2019 after the election. While the fiscal deficit might weigh on public investment to an extent, the wide range of continuing infrastructure projects is likely to support growth in steel demand above 7% in both 2019 and 2020.

Steel demand in developing Asia excluding China is expected to grow by 6.5% and 6.4% in 2019 and 2020 respectively, making it the fastest growing region in the global steel industry. In the ASEAN region, infrastructure development supports demand for steel.

MENA region

Economic diversification efforts in the Gulf coast countries continue in reaction to a low oil price environment but fiscal consolidation is still suppressing construction activities. Steel demand is expected to continue to contract in 2019, with a minor

“Uncertainty over the trade environment and volatility in the financial markets have not yet subsided and could pose downside risks to this forecast”

Al Remeithi, Chairman of the worldsteel Economics Committee

recovery expected in 2020.

Iran's steel demand will also contract in 2019 as the reinstatement of US sanctions causes a recession in the economy.

The situation in North Africa looks brighter, with Egypt recovering strongly after the structural reforms of 2017. Investment in energy and a recovery in the real estate market are expected to drive Egyptian steel demand. Other North African economies are also expected to show resilient growth in steel demand backed by strong investment activities.

The momentum of construction activities is also expected to moderate a bit in the developed economies, but thanks to the rebound in the developing economies, global growth will be maintained at a 3% level in 2019-20. However, in China, Turkey, South Korea and Argentina, construction activities are expected to continue to contract in 2019. With weakening investment and a worsening trade environment, the global machinery sector is expected to show a steady deceleration that will last till 2020, which will be more pronounced in major production hubs such as Germany, Japan and China.

Despite improved oil prices, growth in steel demand in Russia will continue but is expected to be constrained by structural issues. The growth outlook for Ukraine is stable and improving, supported by domestic consumption.

CIS and Turkey

Developing economies present a positive but mixed picture

Steel demand in the emerging economies excluding China is expected to grow by 2.9% and 4.6% in 2019 and 2020 respectively.

The Turkish economy is still reacting to the currency crisis of August 2018, which led to contraction in steel demand. This is expected to continue into 2019, with some stabilisation in 2020.

Latin America

A broad recovery in steel demand across Latin America is expected to continue despite internal and external uncertainty. Recovery in Brazil is in its third year with the construction sector expected to mildly improve in 2019. On the other hand, steel demand growth in Mexico is expected to be moderate, influenced by weak mining investment, fiscal budget constraints, policy uncertainties and a slowing US economy. The political situation in Venezuela and its impact on the region is unclear.

Steel demand from the automotive and construction sectors

As pent-up demand and government stimulus measures subsided, the automotive industry saw a sharp slowdown in growth in 2018 in many countries, in particular in the EU, Turkey and China. The largest decline was observed in Turkey (-9.0%) and in the UK (-5.5%). As a result, global auto production growth decelerated to 2.2% in 2018 from 4.9% in 2017. In 2019, global auto production will continue to decelerate to 1% growth with stabilisation expected in 2020. However, in Latin America, especially in Brazil, auto production will buck the trend and continue to show a steady rebound.

With weakening investment and a worsening trade environment, the global machinery sector is expected to show a steady deceleration that will last till 2020, which will be more pronounced in major production hubs such as Germany, Japan and China.

World Steel Association, Brussels, Belgium

Advanced high strength steel market forecast

Europe leading the AHSS market aiming to enhance production of lightweight vehicles

A smart report published by Fact.MR details that vehicular safety functions are a key growth factor across developed and developing economies, thereby creating constant opportunities for advanced high strength steel manufacturers. This study further enlightens the readers about different market aspects such as market share, forecasted demand and competitive dashboard.

Advanced high strength steel was introduced with a motive to partly address concentrated formability with enhanced strength as a substitute for conventional steels. They were associated with complex geometrical parts which require high formability. Hence, advanced high strength steel is been actively employed across multi-modal applications like automotive rails, front end structures, crash boxes, automotive pillars and doors, as well as sill reinforcements.

According to report findings, sales of advanced high strength steel are experiencing a major surge, in line with mounting preference of end-use industries for materials that possess favorable mechanical properties. It is highlighted that demand for advanced high strength steel is projected to surpass 13.8 million tons in 2019, recording an improvement from 2018. In addition, the report stated that advanced high strength steel market is anticipated to broaden at a volume CAGR of over 10% during the forecast period until 2027.

Global automakers are facing challenges in relation to safety enhancement as well as fuel efficiency improvement. The focus of many automotive manufacturers has been fixed at setting up efficacious solutions, including advanced high strength steel. It is

vital to know that, AHSS delivers greater degree of fuel efficiency, quality, durability and affordability; these features are highly appreciated across the automotive industry.

Automotive light-weighting trend Intensifies the AHSS demand

It is anticipated that with the proliferation of technology hitting a higher path, applications for advanced high strength steel would continue to rise in automobiles. The role of advanced high strength steel will become crucial in enhancing fuel economy, crash safety and engine performance, thereby, making it a practical investment in the automotive sector.

This study by Fact.MR highlights that light-weighting is on the move across different industrial landscapes, including automotive. Interestingly, federal governments all around the globe are daunting safety and fuel regulations, which has pressed OEMs to lessen weight of vehicles as well as associated components. Therefore, this is pushing automakers to contemplate the use of effective materials like advanced high strength steel. Furthermore, automakers are even focusing on vehicular weight reduction

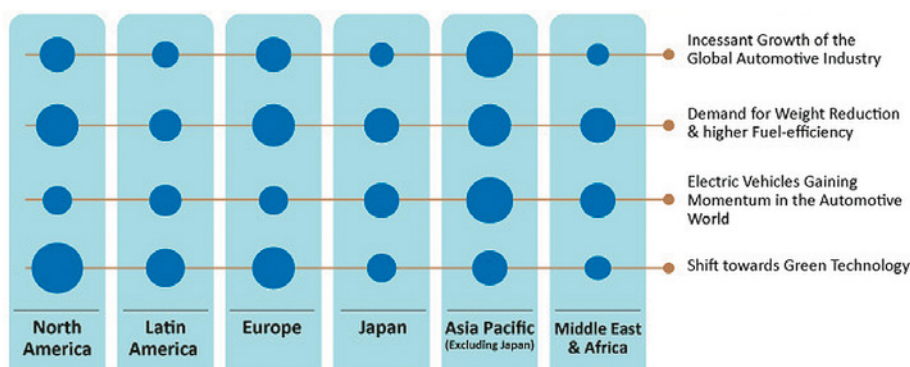
in order to reduce fuel emissions and fulfilling GHG requirements.

Based on this Fact.MR analysis, Europe maintains its leading position as a highly profitable region for advanced high strength steel manufacturers. It should be noted that demand for advanced high strength steel is quite high in Europe, particularly in the EU 5 nations, where the automakers are aiming to reduce vehicular weight in an attempt to fulfill futuristic regulations concerning tail-pipe emissions. It is anticipated that Europe would continue its run as the largest market for advanced high strength steel during 2019, closely followed by North America.

Some of the prime manufacturers from the advanced high strength steel manufacturers market are United States Steel Corporation, Tata Steel Ltd, thyssenkrupp AG, ArcelorMittal SA., Nucor Corp, Baoshan Iron & Steel Co., Ltd, AK Steel Holding Corp, POSCO, SSAB AB and Steel Technologies LLC.

The advanced high strength steel market remains a consolidated landscape, with the monopoly of the leading players. Buoyancy of the leading players in the advanced high strength steel market can be attributed to their global presence, and high orientation toward R&D activities. In addition, leading players are also entering into strategic collaborations with end-use industries to achieve long-term customer retention and repeat sales. Apart from growing with the existing end-user segments, manufacturing companies in the advanced high strength steel market are venturing into niche applications with good growth potential.

Advanced High Strength Steel Market Forecast, Trend Analysis & Competition Tracking - Global Market Insights 2018 to 2027



Note- Size of the bubble shows impact

Global market for advanced high strength steel (Picture: Fact.MR)

Fact.MR, Rockville, MD/USA

Market report

Global metallurgical coke market is expected to reach US\$ 241.1 billion by 2027

The global metallurgical coke market is estimated to be valued at US\$ 186 billion by the end of 2018 and is forecast to reach US\$ 241.1 billion by the end of 2027. The market is projected to grow at a compound annual growth rate (CAGR) of 2.9% during the forecast period. Some factors influencing the growth of the concerned market are growth of construction industry, increasing automotive production and positive global steel production outlook.

Iron and steel production is one of the main application areas of metallurgical coke. Hence, the dynamics of the steel industry will directly impact the metallurgical coke market. Increasing steel demand from various industry verticals is expected to push the growth of steel production, which in turn, is expected to drive the growth of the metallurgical coke market. Growth in infrastructural spending and growing residential and commercial construction are other important factors projected to fuel the demand for metallurgical coke over the forecast period. Moreover, increasing protectionist government stance owing to over production of metallurgical coke and steel by Chinese manufacturers is also expected to significantly influence the global metallurgical coke market during the forecast period.

The growing construction industry is expected to have a positive impact on the global metallurgical coke market. Construction industry is the biggest consumer of steel and any growth in the construction industry pushes the demand for steel, thereby in turn driving the growth of the metallurgical coke market. Developing countries, such as India and ASEAN coun-

tries, are expected to create significant opportunities for the metallurgical coke market owing to increasing government initiatives to promote the domestic manufacturing industry. Further, recovering economic growth and increasing industrial and institutional investments in Latin American Countries, such as Argentina, Brazil and Mexico, will create an optimistic outlook for the growth of the metallurgical coke market.

Metallurgical coke market forecast

The global metallurgical coke market is estimated to witness healthy growth over the forecast period. The global metallurgical coke market is segmented on the basis of product type, ash content and end use and region.

On the basis of product type, the blast furnace coke segment is estimated to have dominated the global metallurgical coke market in 2017 and is expected to maintain its prominence throughout the forecast period. The Technical coke segment is expected to grow at a significant CAGR owing to growing demand from the chemical industry.

Among source ash content segments, the low ash content segment dominates the metallurgical coke market owing to high demand from steel manufacturers. Furthermore, low ash content coke is used in cupola furnace to produce casting products.

By end use, the iron & steel segment accounts for a significant share in the global metallurgical coke market. In 2017, iron & steel segment is estimated to have accounted for more than 87% of metallurgical coke demand. The segment is expected to create incremental \$ opportunity worth US\$ 39.1 billion between 2019 and 2027.

Some of the key market participants reported in this study on the global metallurgical coke market include OKK Koksovny, a.s., SunCoke Energy Inc., Ennore Coke Limited, Hickman, Williams & Company, Mechel PAO, Sino Hua-An International Berhad and Drummond Company, Inc.

**Persistence Market Research Pvt. Ltd.,
New York City, USA**

Persistence Market Research

Persistence Market Research (PMR) is a third-platform research firm. Their research model is a unique collaboration of data analytics and market research methodology to help businesses achieve optimal performance. PMR's new market study titled "Metallurgical Coke Market: Global Industry Analysis 2013–2018 and Forecast 2019–2027" provides in-depth analysis on the global metallurgical coke market and offers an in-depth examination for the forecast period 2019 to 2027. The metallurgical coke market report evaluates the macro & micro economic factors supporting the growth of the global and regional level market. This research study on the metallurgical coke market also offers insights on the market dynamics and competition landscape in the global as well as the regional markets.

Asia

ATI STAL commissions new line

Allegheny Technologies Incorporated (ATI) has commissioned STAL 3, the latest expansion of its 20-year STAL joint venture to produce precision stainless steel strip for China and the Asian markets.

The STAL joint venture was formed in 1995 with the purpose of specializing in the manufacturing and marketing of preci-

sion-rolled stainless steel strip products for the Asian market. It is located in the Xin-Zhuang Industrial Zone of Shanghai. The joint venture brought together what was then Allegheny Ludlum – now Allegheny Technologies – owning 60% and Shanghai No. 10 Iron and Steel Works – now China Baowu Steel Group – owning 40%. It was last expanded in 2007, when STAL 2 was brought on-line.

The recent expansion includes a 1,219 mm wide cold rolling mill enabling production of sheets thinner than a human hair, a bright anneal line and associated auxiliary finishing equipment. STAL's products are sold across Asia, including China, Japan, Korea, Singapore, Vietnam and India.

■ *Allegheny Technologies Incorporated*

Asia

thyssenkrupp to establish Additive Manufacturing TechCenter Hub

The new facility in Singapore is to serve as an extension of the TechCenter for additive manufacturing launched in Mülheim an der Ruhr, Germany in 2017.

The future Singapore Additive Manufacturing TechCenter Hub, supported by the Singapore Economic Development Board (EDB), aims to unlock the potential of additive manufacturing for customers in Singapore and across Asia Pacific.

Additive manufacturing in Asia Pacific is expected to see large growth rates and Sin-

gapore is considered a fertile ground for the innovation to grow. The Research, Innovation and Enterprise 2020 of Singapore, which is the country's roadmap for research and development, includes additive manufacturing as one of the key enablers that will support the country's push for leadership in advanced manufacturing and engineering.

thyssenkrupp's TechCenter Hub in Singapore, together with the existing TechCenter in Germany, will focus on innovations around additive manufacturing solutions in metal and plastic technologies

for customers in automotive, capital goods, chemical, mining and other heavy industries. It will provide a complete range of additive manufacturing services from part identification diagnostics, project delivery to training and capability building. The facility will also host additive manufacturing engineers who will work together with their colleagues in Germany to develop various products and solutions leveraging on this innovation.

■ *thyssenkrupp AG*

Europe

Dillinger expands E-Service with customer app

The new "E-Connect" app provides customers of Dillinger using the E-Service platform added service functionalities.

While customers can find and download information about their orders in Dillinger's E-Service area, including current order status, certificates, invoices, delivery history or tools for plate processing, the app now offers even more practical services: a plate

can be identified quickly and reliably as Dillinger heavy plate by using a smartphone or tablet to scan its barcode or by manually entering the rolled plate number. "Customers can find all certificate information and test results for 'their' plate here. Based on this, they can obtain information on processing with just one more click, including the optimum cooling time during welding or the recommended preheating temperature

during flame cutting," says Dr. Günter Luxenburger, member of the Dillinger board of management. The modular structure allows the app to be continuously adapted to changing requirements through additional, customer-focused developments.

■ *Aktien-Gesellschaft der Dillinger Hüttenwerke*

Europe

kloeckner.i and diva-e join forces

kloeckner.i, the digital unit of international steel distributor Klöckner & Co, and diva-e, a leading Transactional Experience Partner for digital business, have intensified their cooperation and will now offer their consulting services jointly.

Over the past five years, kloeckner.i has accumulated vast experience in digitalizing the internal processes and sales channels of Klöckner & Co. Thanks to diva-e's long-standing support in the technical development of software and platforms,

Klöckner & Co online shops selling steel and metal products have already been launched in six countries. Most recently, the partnership reached another milestone by developing the online shops into platforms through which 30 third-party

vendors now sell complementary products.

Christian Dyck, CEO of kloeckner.i, explains: "On the back of successfully digitalizing Klöckner & Co, we began

offering digital consulting services to external companies at the start of the year. To do this, we cooperate with selected premium partners such as diva-e to ensure we are able to offer our

customers a top-quality, end-to-end consulting and implementation package."

■ *kloeckner.i, diva-e*

Europe

Tibnor acquires Sanistål's steel distribution business

SSAB's subsidiary Tibnor has completed the acquisition of the steel distribution business of Danish Sanistål A/S.

The acquisition was approved by the Danish competition authority in March 2019. It supports SSAB's strategic target to strengthen its Nordic home market position.

The transaction includes Sanistål's modern and highly automated steel distribution center (42,000 m²) in Taulov and four other sales offices in Denmark as well as a sales office in Latvia. Around 130 employees will transfer to Tibnor as part of the transaction. Substantial synergy potential is expected

from the acquisition, as the companies' product offering complement each other very well. For SSAB, the acquisition provides an attractive channel to grow steel sales.

■ *SSAB*

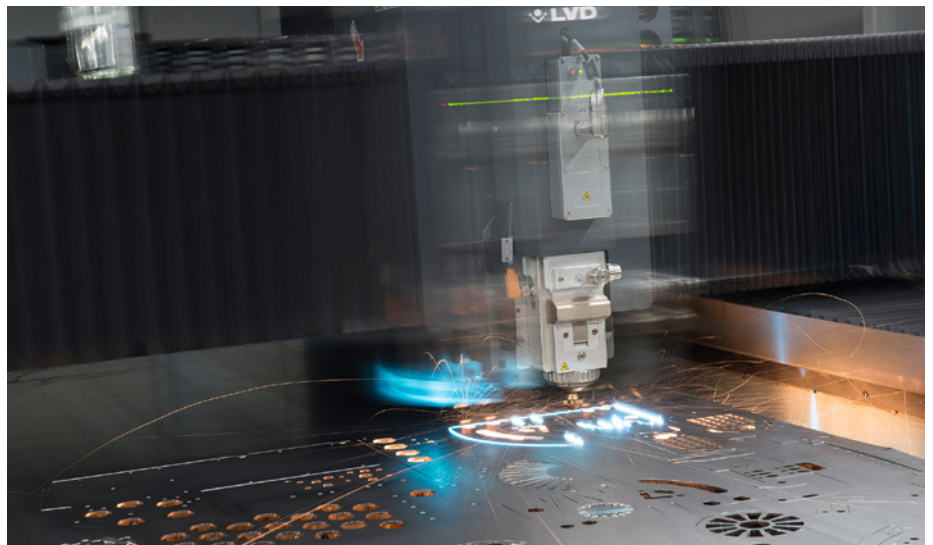
Europe

BE Group becomes SSAB Laser certified partner

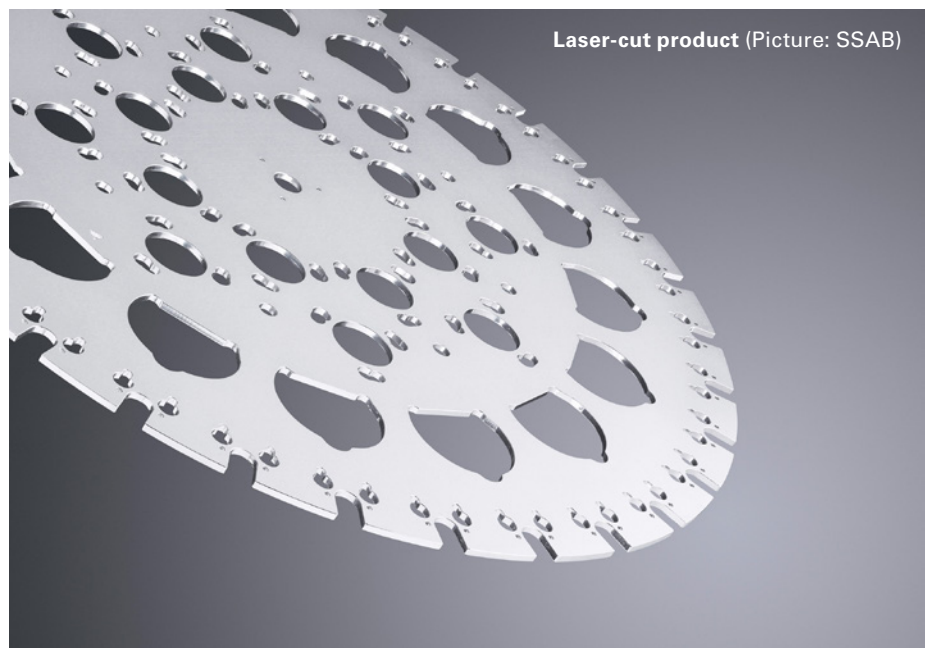
With the addition of BE Group, the distribution network for SSAB Laser® technology now consists of 22 dedicated partners in 13 countries in Europe.

BE Group is a long-standing partner of SSAB in trading hot-rolled plate, strip and tubular products. BE Group's membership of the SSAB Laser® product sales network means customers in Finland and the Baltics can be even more certain of steel availability and fast deliveries. "A growing number of customers can benefit from fast, problem-free cutting with shorter production time, less need for rework and greater precision in the cut components since the network of partners is given thorough training in both the product and its applications," says Jouni Rättyä, senior cross product manager at SSAB Europe.

SSAB Laser® has been especially developed for laser cutting and cold forming with guaranteed flatness, both before and after laser cutting.



Laser cutting with an SSAB Laser® unit (Picture: SSAB)



Laser-cut product (Picture: SSAB)

■ *SSAB*

The Americas

CME Group expands ferrous metals offering with new futures contract

A new U.S. Midwest Hot-Rolled Coil Steel (Platts) Futures contract complements CME Group's existing steel and ferrous metals product suite, and provides customers with another tool to manage regional price risk.

The introduction of this new ferrous contract by CME Group is timely given the ongoing uncertainties around steel prices. The U.S. Midwest Hot-Rolled Coil Steel (Platts)

Futures contract will be 20 short tons in size and will be financially settled against the Platts TSI HRC U.S. EXW Indiana price assessment. Ferrous metals futures and options trading volumes have increased more than 80% since the start of the year to nearly 1,500 contracts traded on average per day. Open interest reached nearly 37,000 contracts at the end of February.

Pending relevant regulatory review periods, the new contract will be available for

trading on CME Globex and for submission for clearing through CME ClearPort, and will be listed with and subject to the rules and regulations of COMEX. As a leading and highly diverse derivatives marketplace, CME Group enables clients to trade futures, options, cash and OTC markets, optimize portfolios, and analyze data.

■ *CME Group*

The Americas

Joint venture between NSBA and Pacesetter

Nippon Steel & Sumikin Bussan Americas, Inc. (NSBA) and Pacesetter have entered into a strategic partnership.

This joint venture will strengthen NSBA's and Pacesetter's position in the

Southwestern United States and Mexico. NSPS Metals has already started construction of its new 12,000 m² steel distribution and processing center in Houston, Texas. According to the plans, later expansion to 24,000 m² is contemplated.

The first development phase of this facility is to be completed in early 2020.

■ *Pacesetter*

The Americas

Forecast of US sheet metal demand

According to a report released by Freedonia Focus Reports, US sheet metal demand is to increase 2.2% yearly in nominal terms through 2023.

Gains are expected in durable goods production, especially transportation equipment and building products. In addition, value gains will be supported by metal prices, which will receive a boost from

anticipated reductions in steel production in China. Through 2023, the leading transportation equipment market is expected to register the fastest growth among the discrete sheet metal markets. Continuing market adoption of high-value-added sheet metal capable of improving vehicle fuel efficiency and safety will drive gains.

These and other key insights are featured in the Sheet Metal: United States report.

Total demand is segmented by material in terms of hot-rolled steel, cold-rolled steel, aluminium, copper, other metals such as nickel, titanium, and zinc, and by market, such as transportation equipment, building products, machinery appliances, electrical equipment, electronics, packaging, etc.

■ *The Freedonia Group*

The Americas

Maksteel USA completes acquisition of LexWest Steel

Union Partners has announced that one of its steel service centers, Maksteel, has completed the acquisition of LexWest Steel based in Los Angeles, California.

With the addition of LexWest, Canada-based Maksteel now operates out of nine facilities in the USA and Canada. Its

US distribution now spans from the mid-west and south regions to strategic locations in Los Angeles, California, and a soon-to-be announced expansion in Arizona.

LexWest Steel was founded in 2001 and currently operates out of Los Angeles, with sales offices in Arizona and Texas. The company offers slitting and cut-to-length

capabilities, and carries a variety of hot rolled, cold rolled, coated and pre-painted flat rolled products. LexWest Steel is a full-line distributor of flat rolled steel products and has been rebranded as Maksteel USA.

■ *Union Partners*

Nickel in deficit

Growing demand for Nickel drives increased investments in Indonesian Nickel sector

As the world's leading source of nickel, Indonesia is seeing serious investments. Pacific Rim Cobalt Corporation just announced assay results from its ongoing 2019 drilling campaign. VALE S.A. has also invested heavily in Indonesian nickel production. Glencore both mines nickel and recycles it from old batteries. Lundin Mining Corporation produces nickel and its byproducts in four countries. Cobalt 27 Capital Corporation has invested in a nickel mine in Papua New Guinea that, like Indonesia, offers good access to customers in Chinese industry.

Batteries play a vital role in modern society, powering everything from torches and phones to electric cars. While the role of cobalt and lithium in these batteries is widely recognized, nickel is also critically important. The mineral features in a wide range of batteries, including the majority of electric cars.

Nickel also plays an important part in steel production, which led to a surge in demand from China a decade and a half ago. At that time, production efforts increased to meet the demand; today, the growing importance of nickel in batteries is causing fresh pressure, along with a supply deficit. This increasing need for nickel has sparked more investments in nickel-producing regions — specifically Indonesia, the world's largest nickel producer.

Drilling results confirm assessment of the Cyclops project

One of the companies making that kind of investment is **Pacific Rim Cobalt Corp.**, which has been actively involved in a drilling project located on the northern shore of Indonesia, near China, which boasts the world's largest electric vehicle battery market. This week the company announced results from eight of the first fifteen holes drilled in the Yapase area of the Cyclops project. The drilling confirmed the development of a complete mineralized laterite profile and is starting to confirm grades and widths that form the basis of the project's historical estimate.

"The latest drill results continue to confirm our initial impression, assessment and observations of the project's potential, which is beneficially located in proximity to the world's largest buyer of battery metals. We expect the near-surface nature of

cobalt and nickel mineralization at the Cyclops project will lend itself well to low-cost, logistically straightforward drilling", said Pacific Rim CEO Ranjeet Sundher.

The company began a 50-hole core drilling program in mid-January on areas of laterite delineated by a geological mapping and a hand-auger geochemistry program. A total of 15 holes have been completed, covering a total of 255 m, with hole depths ranging from 13 to 29 m.

The drive for clean energy

The news from Pacific Rim comes as interest in electric vehicles — and demand for the batteries needed to power them — is gaining significant momentum. One of the most compelling reasons behind that increased demand is the desire for clean energy.

As climate change disrupts weather patterns and destabilizes lives around the world, industrialized countries are starting to recognize that change as not just an environmental challenge but a security one. Those countries have responded by implementing clean-energy and clean-air policies, which are transforming the way that automobile companies work.

More than 40 automakers are pivoting towards electric vehicles. While Tesla is grabbing most of the headlines, most recently by reducing the price on its Model 3 to make electric cars more widespread, more established car companies are also getting into the game. It took five years to sell the first million EVs but just six months to sell the last million. Hybrid cars are increasingly common, as are the charging points they need, and all but one of the major electric vehicle manufacturers use nickel in their batteries.

This is creating the demand that Pacific Rim is strategically working to address. As electric cars come to dominate the roads, the demand for the minerals used in them is set to soar.

Getting ahead of the Nickel race

The world's largest source of nickel production by nation is Indonesia. The country is rich with sources of the metal, many of which have yet to be effectively exploited. But this is not the only reason why Indonesia is a natural home for Pacific Rim's Cyclops project.

Located on the western rim of the Pacific, Indonesia is well positioned for exporting to China, the world's largest consumer of battery metals. China has seen massive economic development in recent decades, thanks to the modernizing efforts of the country's leaders. While modernization can be hard to balance with environmental protection, the Chinese leadership are well aware of the problems caused by environmental degradation, not the least of which is due to the heavy pollution in major Chinese cities. Those leaders are therefore encouraging clean alternatives, leading to a boom in electric car research and development.

Investing in exports to China is a sound strategy for any company specializing in battery metals. The country not only produces batteries for its own use but also makes them for export, thus creating a fresh wave of demand for nickel in a country that drove a previous nickel boom just after the millennium. This boom is drawing more companies to Indonesia. By setting up a fresh nickel and cobalt mining operation within easy reach of China, Pacific Rim is tapping into both supply and demand,

ensuring an accessible market for its products.

Pacific Rim has positioned itself as an early mover in the race for Indonesia battery metals. The company has gained 100 percent control of the 5,000 hectare nickel and cobalt Cyclops Project. With production and environmental permits secured, the project benefits from excellent infrastructure, including close proximity to an eager workforce and supplies, sealed roads, ocean access, nearby port facility and gentle topography. The existing road system also enables year-round access to the project and connections to key nearby cities, including Sentani and Jayapura.

Digging deeper for Nickel

As demand rises, several companies are expanding their interest in nickel.

VALE S.A. is the world's largest nickel manufacturer and, like Pacific Rim, it has made Indonesia an important part of its mining strategy. The country is one of four where Vale operates, alongside Brazil, Canada, and New Caledonia. Vale has spent billions on developing Indonesian

nickel production for export to countries including China. Vale makes a substantial effort to have a positive impact in the communities where it mines, with policies designed to mitigate the environmental impact of mining and to provide social benefits to locals. This is reflected in the fast moves Vale has made in response to a dam breach at Brumadinho, where it has poured money into helping locals affected by the accident and taken steps to protect the local environment even as it sets to work on rebuilding.

Glencore, one of the world's largest diversified natural resources companies, is also heavily invested in mining for battery metals. Assets in Australia, Canada and Europe produce the company's supply of nickel, as well as byproduct metals such as cobalt and copper. In addition to mining nickel, Glencore is one of the largest recyclers and processors of nickel-bearing products such as batteries, taking the minerals from discarded goods and finding ways to reuse them.

A diversified Canadian-based metal company, **Lundin Mining** Corporation

has operations in Chile, the United States, Portugal and Sweden. Nickel is one of its leading products, alongside copper and zinc. Good results in the fourth quarter ensured that the company achieved or exceeded its production targets at all its operations in 2018, providing plenty of material for use in batteries and other manufacturing.

A leading nickel and cobalt investment vehicle, **Cobalt 27** Capital Corporation offers investors a chance to profit off the technologies behind energy storage and electric vehicles. To this end, it is investing in nickel production through a mine in Papua New Guinea. Like Indonesian Papua, Papua New Guinea is rich in nickel deposits and well located for exports across the Pacific to China.

Nickel's central place in battery production, and so in meeting rising EV sales and building greener technology, should ensure heavy investment from companies for years to come, in Indonesia and beyond.

■ *NetworkNewsWire, New York, NY/USA*

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This guitar is smash proof, but it can be used to smash other things (Picture: Sandvik AB)



Movie about the guitar
on YouTube
(youtu.be/k1hxZyD9VGI)



Impressive musical instrument made of steel

World's first all-metal, smash-proof guitar

Sandvik created a smash-proof, 3D printed guitar, then challenged rock legend Yngwie Malmsteen to smash it. The guitar was to demonstrate how advanced, precise and sustainable the company's techniques are.

Rock stars have been smashing guitars for decades, few with more enthusiasm than Swedish-born guitar virtuoso Yngwie Malmsteen. Global engineering company Sandvik decided to test their cutting-edge techniques by building the world's first all-metal, unbreakable guitar and letting Malmsteen unleash his smashing skills on it.

"We don't make products for consumers, so people don't realize how far in the forefront our methods are," says Klas Forsström, president of Sandvik Machining Solutions. "Creating a smash-proof guitar for a demanding musician like Malmsteen highlights the capabilities we bring to all complex manufacturing challenges."

Malmsteen, named one of the ten greatest electric guitar players in the world by TIME Magazine, is known for his virtuoso performances – as well as the fury he unleashes on his guitars. A master of neo-classical heavy metal, Malmsteen has produced 30 albums and has been smashing guitars onstage for over 30 years.

"This guitar is a beast! Sandvik is obviously on top of their game. They put the work in, they do their hours, I can relate to that," Malmsteen said. "The result is

"Additive manufacturing allows us to create lighter, stronger and more flexible components with internal structures that would be impossible to mill traditionally."

Amelie Norrby, additive manufacturing engineer at Sandvik



Yngwie Malmsteen discussing with the Sandvik team about the design details of the components of the guitar (Picture: Sandvik AB)

amazing. I gave everything I had, but it was impossible to smash."

Guitar's neck and hub made as one piece

Sandvik engineers teamed with renowned guitar designer Andy Holt, of Drewman Guitars, to match Malmsteen's exacting musical standards and his lightning-fast playing style. "We've had to innovate from the top down. There's not a single part of this guitar that has been made before. It's a piece of art, really," Holt said.

The weak point in any guitar is where the neck joins the body. Sandvik solved the problem by milling the neck and the main hub of the body as one piece. "You could use the guitar as a hammer and it wouldn't break," Holt said.

The guitar's neck and fretboard were machined by Sandvik Coromant in one machine from a solid block of stainless steel. "Precision was critical," said Henrik Loikkanen, machining process developer at Sandvik Coromant. "Our software is built on years of experience, giving tool and the cutting data recommendations that helped us mill the fretboard down to a challenging thickness of one millimeter in places."

Guitar's body was additively manufactured

The next challenge was to strengthen the fret and neck as they extended into the guitar's body. That solution took the form of a new, super-light lattice structure that



"The guitar's neck is the most sensitive component," says Yngwie Malmsteen, signing the guitar
(Picture: Sandvik AB)

was sandwiched between the guitar's neck and fretboard. Made from hyper-duplex steel, a recent Sandvik innovation, the lattice structure is the strongest in the world for a given weight.

Several different divisions of Sandvik collaborated to make the instrument. For the guitar's 3D printed body, Sandvik relied on its world-leading expertise in metal powder and additive manufacturing. Lasers traced a design in beds of fine titanium powder, fusing layers of material one on top of the other. The layers, each thinner than a human hair, built up to make the body of the guitar.

"Additive manufacturing allows us to build highly complex designs in small production runs," said Amelie Norrby, additive manufacturing engineer at Sandvik. "It lets

us create lighter, stronger and more flexible components with internal structures that would be impossible to mill traditionally. And it is more sustainable because you only use the material you need for the component, minimizing waste."

"Collaborating like this, working together to solve even more complex problems is key for the future," said Tomas Forsman, product development specialist at Sandvik. "Our customers' challenges continue to grow more and more complex. We need to bring our expertise to work hand-in-hand with our partners and customers to invent new ways of meeting those challenges."

| Sandvik



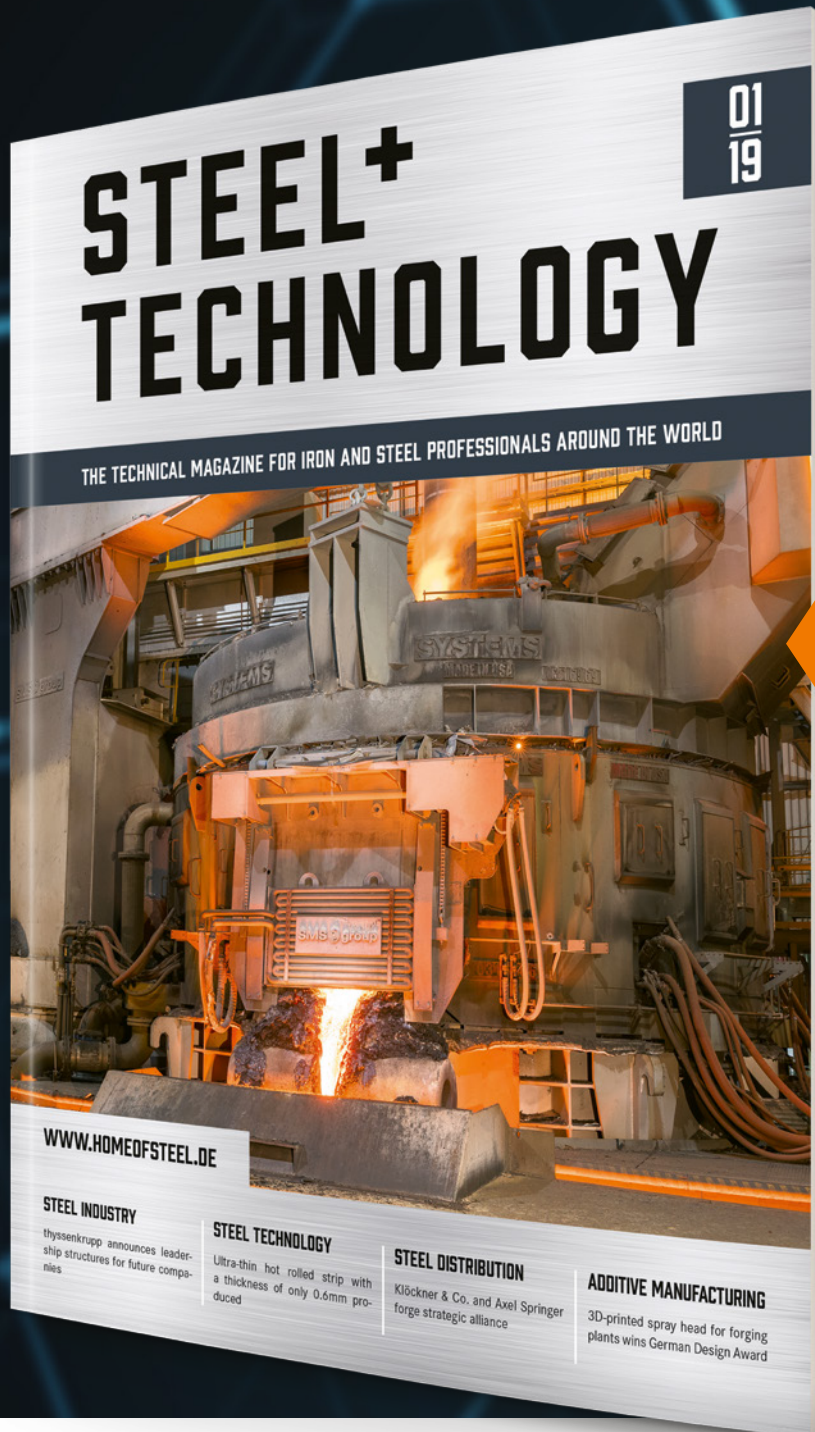
A new, super-light lattice structure made from Sandvik's hyper-duplex steel (Picture: Sandvik AB)

Facts about the guitar

- The guitar body was produced by additive manufacturing, or 3D printing, a technique involving laser-melting titanium powder in microscopically thin layers.
- The guitar's volume knobs and tailpiece, which anchors the strings, were also created with 3D printing.
- The guitar neck and hub were made of recycled stainless steel and milled all in one machine in one continuous process. Extra material was milled from between frets to meet Malmsteen's preference for a scalloped fretboard. The back of the guitar's neck is hollowed out from the inside and is only 1 mm thick in places.
- Advanced software allowed Sandvik Coromant to simulate milling digitally before the first cut was made, enabling the correct choice of tools, saving manufacturing time and ensuring desirable outcomes.
- Made of Sandvik's hyper-duplex steel, the lattice structure used inside the guitar neck is the strongest structure in the world.
- Before the guitar was built, Sandvik simulated potential impact forces in the same way as car makers digitally crash-test new models.

The new technical journal

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ESTAD – European Steel Technology and Application Days	24 – 28 June 2019 Düsseldorf, Germany	Stahlinstitut VDEh www.metec-estad2019.com
European Steel Day	26 June 2019 Brussels, Belgium	EUROFER www.europeansteelday.eu
STEELSIM – Modeling and Simulation of Metallurgical Processes in Steelmaking	13 – 15 August 2019 Toronto, Canada	Association for Iron & Steel Technology (AIST) www.aist.org/conference-expositions/steelsim
ESSC – European Stainless Steel & Duplex Stainless Steel Conference	30 Sep – 2 Oct 2019 Vienna, Austria	Austrian Society for Metallurgy and Materials (ASMET), www.stainlesssteel2019.org
Alacero 60 – Latin American Steel Congress	11 – 13 November 2019 Buenos Aires, Argentina	Alacero - Latin American Steel Association www.alacero.org
Hüttentag 2019	7 November 2019 Essen, Germany	DVS Media GmbH www.homeofsteel.de

Exhibitions, trade fairs

GIFA, METEC, THERMPROCESS, NEWCAST	5 – 29 JUNE 2019 Düsseldorf, Germany	Messe Düsseldorf www.tbwom.com
EMO 2019 – The world of metalworking	16 – 21 September 2019 Hanover, Germany	Verein Deutscher Werkzeugmaschinenfabriken www.emo-hannover.de
Metal Expo 2019	12 – 15 November 2019 Moscow, Russia	Metal Expo (Exhibition) www.metal-expo.ru

Seminars

Continuous Casting	6 – 29 August 2019 Cologne, Germany	Steel Academy of the Steel Institute VDEh www.steel-academy.com
ABM Week 2019	1 – 4 October 2019 Sao Paulo, Brazil	ABM – Brazilian Metallurgy, Materials and Mining Association, www.abmbrasil.com.br
7th AIST European Steel Forum 2019	23 - 25 October 2019 Leoben, Austria	Association for Iron & Steel Technology (AIST) www.aist.org/conference-expositions/
Refractory Technology I	4 – 27 November 2019 Cologne, Germany	Steel Academy of the Steel Institute VDEh www.steel-academy.com

Preview of the September 2019 issue

Steel technology

Using hydrogen in commercial blast furnaces

German Dillinger and Saarstahl are taking a new approach to reduce CO₂ emissions in ironmaking. The companies will for the first time use hydrogen-rich coke

gas in the two blast furnaces of ROGESA. An investment volume of €14 million will spent to significantly reduce CO₂ emissions at the Dillingen site.

Steel processing

Yildiz Group has entered the steel business in Turkey

Yildiz Demir Celik built a completely new cold mill complex in Kocaeli, Northern Turkey. to produce 1.5 million t/year of pickled, cold-rolled, galvanized and annealed, and skin-passed coils, starting from incoming hot-rolled coils. At the

beginning of 2018 it started operating in sequence, and now is producing in excess of the contractual rate. One of the key production facilities is the new continuous pickling line coupled with a five-stand six-high tandem cold mill.

Steel trade

Weathering steel market to grow significantly by 2024

Major drivers of the market include the increasing demand from various end-use industries, government initiatives, and public & private investments Asia Pacific is projected to be the largest

consumer of weathering steel during the forecast period. Plates are expected to be the most consumed form of weathering steel during the forecast period.

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