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### EVENTS

Successful premiere of Germany's new premier annual event HÜTTENTAG

### STEEL TECHNOLOGY

From liquid steel to rolling: Concepts and applications for efficiency and zero waste

### STEEL DISTRIBUTION

Milestone in B2B e-commerce: new online portal goes live

### STEEL PROCESSING

Efficient sheet metal blank production with laser cutting line



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## Success is feasible – even in challenging times

According to worldsteel, global steel demand remains resilient despite an uncertain economic environment. The short range outlook released by the World Steel Association is included in this issue. Steel demand varies greatly in the different regions of the world. worldsteel states that the automotive sector weakens as a result not only of economic factors, but also due to customer hesitancy during the transition from combustion engines via hybrid drives to fully electric vehicles. This transition certainly involves a shift towards a higher demand for electrical steel, but also for next-generation advanced high-strength steels and other new steel grades. Consequently, steel producers have been adjusting their production capabilities accordingly.

One case example is the new flat steel complex Steel Dynamics Inc. is going to build in Texas (USA). The motivation behind this project is not just an expansion of production capacity. Mark D. Millet, President and CEO, said that the new mini mill “should allow us to achieve steel grades previously out of reach to thin-slab casting technology, while sustaining the low-energy and low-carbon footprint - that is at the core of our steelmaking operations”. In this issue of Steel and Technology, we outline the key parameters of the project. The article is followed by a summary of what is considered the next-generation approach to steelmaking - in terms of steel products, technologies and market orientation. Built to substitute steel imports in the United States, the “learning steel mill” at Big River Steel has set a new benchmark in the USA, using state-of-the-art process technology to produce ultra-low carbon steels for automotive grades, electrical steels and near segregation-free sour service grade line pipe steels. It is not by chance that U. S. Steel Corporation, one of the biggest players in the North-American steel sector, has just taken a stake in Big River Steel. “A true milestone for our 118-year old company,” said David B. Burritt, President and Chief Executive Officer of U. S. Steel. “The closing of our investment in Big River brings us one step closer to creating a differentiated, world-competitive company that can offer our customers, employees and stockholders the ‘best of both’ integrated and mini mill steel making technology. We have done more than make an investment in the newest and most advanced flat-rolled mill in North America ... we have invested in the future of U. S. Steel.” These words speak for themselves.

Also the other articles in this issue feature topics of key relevance for a successful development of our economies - concepts and applications for higher efficiency and zero-waste, for example – and aspects such as safety issues, which play a critical part in sustainable, disruption-free steelmaking today. There are many approaches to success – even in difficult times.



**Arnt Hannewald**, Dipl.Ing.  
Editor

*Arnt Hannewald*

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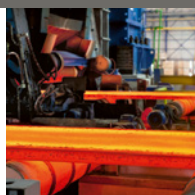
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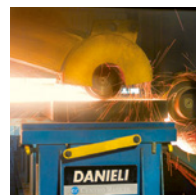
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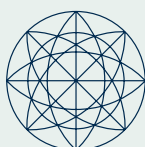
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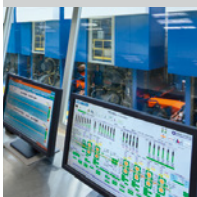
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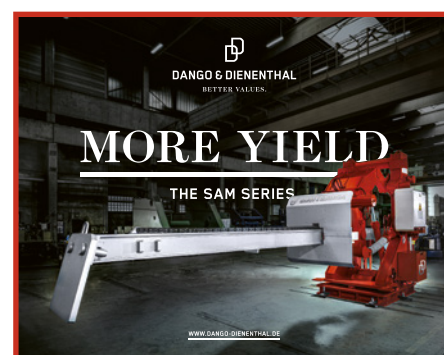
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Cover picture:  
Dango & Diententhal Maschinen-  
bau GmbH, Siegen, Germany



## AMI Automation Meltshop Solutions Group announces new team member



**Thierry Koeger has joined AMI Automation as senior technical specialist for Europe and Asia.**

AMI Automation, with its global headquarters in Monterrey, Mexico, supplies technology including hardware, software and service to optimize drive systems and EAF industrial processes. Thierry Koeger will

**Thierry Koeger joins AMI's European technical service team.** (Picture: AMI Automation)

be part of AMI's European technical service team.

Thierry Koeger is a steel industry veteran with over 20 years of experience with a German OEM installing electrode regulation systems for EAF operations. Based in France, his responsibilities include technical support for electrode regulation, automation and AMI's SmartFurnace Optimization products and services.

**| AMI Automation**

## New chair of the board and CEO at ArcelorMittal Italia

**Lucia Morselli has been appointed as chairwoman of the board and CEO of ArcelorMittal Italia.**

Lucia Morselli replaces Matthieu Jehl, the current chairman and CEO, who will

take up new responsibilities within ArcelorMittal. Lucia Morselli is a member of the board of directors at Essilor-Luxottica, Telecom Italia SPA, Sisal SPA and ST Microelectronics. She is a highly experienced chief executive having held the

position at numerous companies including Acciai Speciali Terni and Berco Group.

**| ArcelorMittal**

## John J. Ferriola to retire as chairman and CEO of Nucor

**Leon J. Topalian has been elected by the board of directors of Nucor Corporation to be president and chief operating officer. He will succeed John J. Ferriola as CEO, who will retire at the end of this year after having served Nucor for 28 years.**

John J. Ferriola joined Nucor in 1991 as the manager of maintenance and engineering at Nucor Steel-Texas. Most recently, he has served as chairman since 2014 and as CEO since 2013.

Leon J. Topalian has been employed by Nucor in various capacities since 1996,

including serving as general manager at two Nucor facilities, in Arkansas and Illinois. He has been executive vice president of Nucor from 2017 to 2019.

**| Nucor Corporation**

## New executive appointments at Kloeckner Metals

**Kloeckner Metals Corporation has appointed CEO John Ganem to the management board of parent company Klöckner & Co. Andrea Moseley from Klöckner & Co will return to the Kloeckner Metals team as its executive vice president of finance.**

Klöckner & Co.'s management board now consists of Gisbert Rühl, CEO Europe, Dr. Oliver Falk, CFO Europe,

and John Ganem CEO Americas. John Ganem's election demonstrates Klöckner & Co.'s commitment to decentralizing its digitization activities and building a more independent, entrepreneurial organization in the USA and across the 13 countries it operates.

Andrea Moseley is a seasoned executive who started her career at Kloeckner Metals in 2002. She served as Klöckner & Co's head of governance

and finance transformation in Duisburg, Germany since June 2017. In her new position at Kloeckner Metals, she will have responsibility for the shared services and legal departments in addition to her previous responsibilities for M&A and treasury/finance.

**| Kloeckner Metals**

## Liberty strengthens sales and marketing activities in the US market

**Liberty Steel USA, part of Sanjeev Gupta's global GFG Alliance, has appointed Tim Dillon as a senior vice-president of sales and marketing**

The appointment follows a series of acquisitions over the past year which have quickly established Liberty as a major player in the American wire rod market, with

production capacity in the Mid West and on the East Coast.

In a 40-year career, which began with the United States Steel Corporation and

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encompassed American Steel and Wire/Birmingham Steel, GS Industries, Georgetown Steel/ISG and Baron Drawn Steel, Michigan, where he was president, Tim Dillon has consistently distinguished him-

self by leading strong sales growth in multiple scenarios including start-ups, restarts and major expansions. In his new role he will lead all sales, marketing and customer support activities both in Liberty Steel

USA's current markets and in future target sectors.

■ *Liberty Steel*

## New managing director of NLMK Lipetsk

**NLMK Group has appointed Vyacheslav Vorotnikov as managing director of NLMK Lipetsk. He succeeds Sergey Filatov, who has stepped down as managing director for family reasons.**

Sergey Filatov will stay on with NLMK Group as advisor to the president. Vyacheslav Vorotnikov joined NLMK in 1975, holding various positions at the cold rolling operations, before being appointed

Deputy Sales Director from 1998 to 2000. From 2000 to 2010 he served as Deputy Director of Production.

■ *NLMK*

## George J. Koenig appointed chief commercial officer at Phoenix Services

**Phoenix Services LLC, specialists in metal recovery and industrial services, has named George J. Koenig as CEO.**

In this new position, George Koenig will have responsibility for providing innova-

tive and customized solutions for the global metals industry, and helping direct the strategic growth initiatives for Phoenix. Georg Koenig was CEO of Berry Metal for many years. He has recently served as President of the Association for Iron &

Steel Technology (AIST). Prior to Phoenix Services, George Koenig led the global development efforts, iron and steel, for Hatch Engineering.

■ *Phoenix Services*

## Succession of chief financial officer at Russel Metals

**Marion E. Britton, executive vice president and chief financial officer of Russel Metals will retire in 2020. To ensure a smooth transition, she will remain with the company during 2020.**

Marion E. Britton began her career in the metals industry in 1984 with Marshall Drummond McCall, which was acquired by Russel Metals in 1987. She steadily progressed with the company by taking on new roles and additional responsibilities, culminating with

her appointment as executive vice president and CFO in 2008. Russel Metals has begun an extensive search for her replacement.

■ *Russel Metals*

## Personnel changes on executive board of thyssenkrupp



Martina Merz, chairwoman of the supervisory board, has been delegated to act as CEO of thyssenkrupp AG for an interim period. (Picture: thyssenkrupp)

**After the termination of the executive board mandate of Guido Kerkhoff by mutual agreement, Martina Merz has taken over as CEO of thyssenkrupp AG.**

The current chairwoman of the supervisory board has been delegated to the group executive board for a maximum period of twelve months, after which she will return to the supervisory board.

With the delegation of Martina Merz, the supervisory board followed the recommendations of the personnel committee. In addition, the supervisory board appointed Dr. Klaus Keysberg to the executive board of thyssenkrupp AG. Keysberg, who will be responsible

for the materials businesses on the group executive board, has held various positions at thyssenkrupp since 1996 and has been CEO of the Business Area Materials Services since the beginning of the year. He will continue to hold this position until a successor is appointed.

Martina Merz's successor at the head of the supervisory board will be Prof. Dr. Siegfried Russwurm. The former Siemens executive board member has been a member of the supervisory board since April 2019.

■ *thyssenkrupp*

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**Terry L. Dunlap, interim chief executive officer and president of TimkenSteel**  
(Picture: TimkenSteel)

## CEO transition at TimkenSteel

**Ward J. "Tim" Timken, Jr. has stepped down as chief executive officer and president and as chairman of the TimkenSteel board of directors.**

Tim Timken lead TimkenSteel on its journey as an independent public company. The board has appointed Terry L. Dunlap as the company's interim chief executive officer and president. John P. Reilly, the current lead director of the TimkenSteel board of directors, will immediately assume the role of chairman of the board.

Terry Dunlap has been a director of TimkenSteel since August 2015 and has served on the audit committee and

compensation committee of the board of directors. He has experience in areas critical to improving TimkenSteel's business, including sales, marketing, manufacturing and operations, supply chain, procurement and information technology.

John P. Reilly is a founding member of TimkenSteel's board of directors since the company's spinoff in 2014, and also serves on the nominating and corporate governance committee and audit committee of the board of directors.

**| TimkenSteel**

## REPUBLIC OF SOUTH AFRICA

### Acerinox to revamp slab caster of Columbus Stainless

**Acerinox has contracted Danieli Automation for the electrical and automation revamp of the stainless steel slab caster at Columbus Stainless (Pty) Ltd., Mpumalanga.**

Columbus Stainless produces austenitic and ferritic stainless steels, duplex stain-

less in plate, sheet, coil and strip. With a maximum casting capacity of 72,000 t/month, the continuous casting machine, originally installed in the 1990s, has become a production bottleneck for the plant. The revamp to be supplied on a turn-key basis will include new PLC and SCADA systems, conversion of 18 motors/drives

from DC to AC power supply, and the complete replacement of Level 2 with Danieli Automation Q-CAST, including the Q-ART, Q-CUT, Q-MIX and Q-COOL technological packages.

**| Danieli**

## CANADA

### Ampco-Pittsburgh sells specialty steel operations

**Ampco-Pittsburgh Corporation has sold its Canadian specialty steel subsidiary, ASW Steel Inc., to Valbruna Canada Ltd.**

With production facilities located in Fort Wayne, Indiana, and in Italy, and with

worldwide distribution including a service center in Milton, Ontario, Canada, Valbruna is a leading producer of stainless steels, nickel alloys, and titanium long products. It has an annual output of approximately 200,000 t of specialty steels. The divestiture of ASW is con-

sistent with Ampco-Pittsburgh's strategy to concentrate on assets in the forged and cast engineered products segment.

**| Ampco-Pittsburgh Corporation**

## BRAZIL

### ArcelorMittal places order for spare parts management system

**Danieli is going to install its Consignment Stock (C-Stock) system at ArcelorMittal's Piracicaba plant.**

Danieli C-Stock is an on-demand warehouse management system, particularly useful for high-turnover items, such as

wear parts. The system avoids costly procurement, assures availability and continuity of operation, and prevents downtime due to missing parts. The agreement with AM Piracicaba provides for the stock being stored in the Danieli do Brazil warehouse and delivered quick-

ly upon request by ArcelorMittal. Danieli's local team will also advise Arcelor on stock optimization according to actual plant needs.

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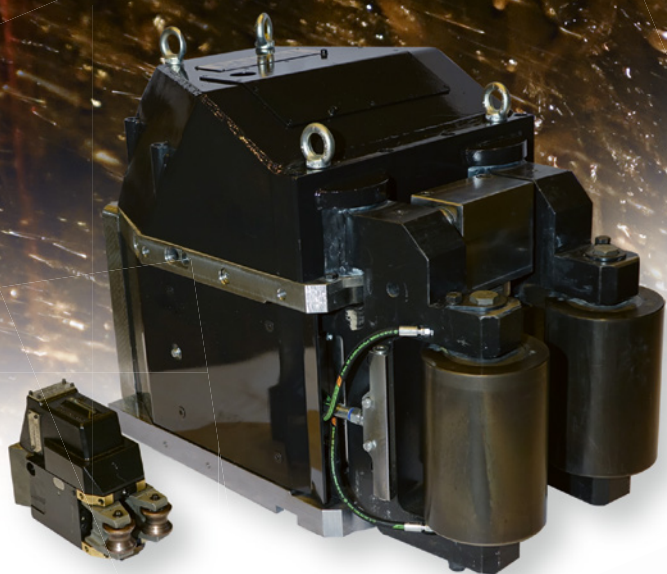
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## BRAZIL

### Gerdau Pindamonhangaba upgrades rolling mill

**Danieli Service do Brasil has upgraded the No. 3 rolling mill at Gerdau Pindamonhangaba, São Paulo, to enable the production of spring steel flat bars.**

The rolling mill, recently supplied by Danieli, was initially designed for the production of specialty steel round bars. It has

now been upgraded for the production of spring steel flat bars in addition to round bars. The project consisted of advisory technical services, expertise sharing, and equipment supply, including new cooling bed eccentric shafts and pneumatic apron flaps. On-site activities, such as dismantling, mounting, cold and hot commissioning, were also part of the supply.

The very first flat bars – produced ahead of schedule – already featured optimal surface quality and metallurgical properties. The project will continue with a second phase aiming to increase the dimensional range.

**| Danieli**

## MEXICO

### Ternium Pesqueria implements fully automated slab handling

**Danieli is to supply an inventory management system and fully automatic handling equipment to Ternium for its greenfield hot-strip mill in Pesqueria.**

The purpose of this investment is to optimize incoming slab flow by applying artificial intelligence for the slab yard management system, in direct connection and

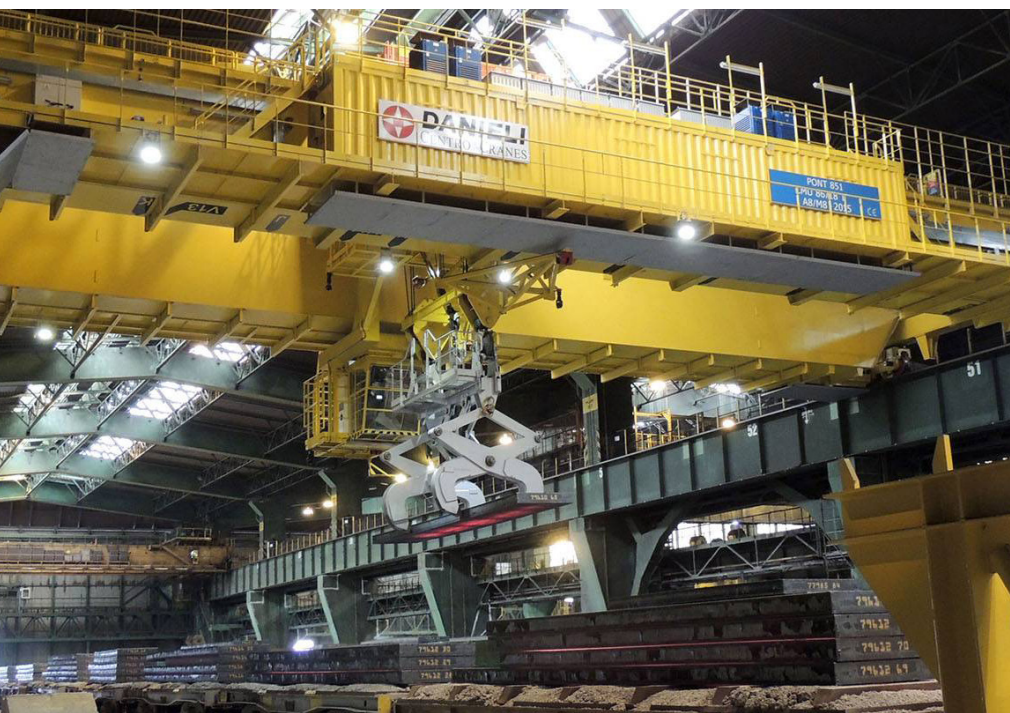
communication with the downstream process of the hot-strip mill.

The handling system – including ten electric overhead travelling cranes, seven transfer cars and two destackers – will distribute and transfer slabs through the intermediate and final storage areas. The slab yard management system calculates the tasks for all equipment according to the forecast production mix submitted by the plant MES, optimizing the movements and the relocation of each slab. The processes are adapted in real-time to the actual needs determined by the product mix and the equipment status.

Slabs are moved by autonomous transfer cars from the arrival bays to the reheating-furnace charging bays, where they are stored according to the reheating-furnace charging sequence in order to optimize the crane and loading cycles and increase the flexibility in case of a change in the production schedule.

Properly sequenced slabs are stacked below two destackers, which continuously load slabs on a 50-m-long roller table, and feed them directly into the hot-strip mill furnace, according to the production mix and required schedule.

**| Danieli**



Overhead travelling cranes are central elements of the slab handling system. (Picture: Danieli)

## USA

### Benteler Steel's new quality seamless pipe mill in full production

**Benteler Steel has started to supply pipes produced on the new seamless pipe mill supplied by Danieli to the recovering oil and gas market.**

Danieli Centro Tube has received the final acceptance for the 5½" FQM seamless pipe mill at Benteler Steel's pipe plant in Shreveport, LA. The plant is now in full production

after the critical period of low oil prices, and a sluggish tube and pipe market.

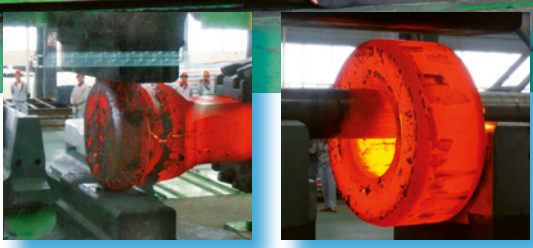
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Amir Tanbakouchi

Sales Manager North America, Russia, Middle East





## USA

**U.S. Steel to acquire shares in Big River Steel****Joint venture partnership agreement aligns the two companies for future acquisition**

United States Steel Corporation (U. S. Steel) and Big River Steel, Osceola, AR, will form a joint venture under which U. S. Steel will hold a 49.9% ownership interest. Big River Steel will receive US\$700 million in cash in return. As part of its investment, U. S. Steel will hold an option to acquire

the remaining 50.1%. Big River Steel's original owners will also hold certain options related to the future ownership make up of Big River Steel should U. S. Steel choose not to exercise its option.

Since production began in early-2017, Big River Steel has already positioned itself as one of the premier steel producers in North America in terms of profitability, product quality, employee productivity and environmental sustainability. Big River Steel will

double production capacity from 1.65 million short tons to 3.3 million short tons of flat-rolled steel. This investment will facilitate the company's ability to produce even higher grades of electrical steel, demand for which is expected to increase with continued focus on energy efficiency and the increase in hybrid and electric vehicle sales.

**| Big River Steel**

**North Star BlueScope orders furnaces****North Star BlueScope Steel has placed an order with Andritz for the supply of a tunnel furnace along with two shuttle furnaces.**

The shuttle furnaces will be used to convey the slabs from both casters to the two-stand roughing mill at the Delta, Ohio

plant. Besides the furnace equipment, Andritz will supply Level 1 and Level 2 automation systems. The shuttle furnaces will be installed during the fourth quarter of 2020. The tunnel furnace is scheduled to start production by the end of 2021.

This furnace order is part of an expansion project by North Star BlueScope that

will add a third electric arc furnace, a second continuous caster and the furnace equipment mentioned. The expansion will increase the annual capacity by 800,000 to 900,000 t.

**| Andritz**

**Bluestone Resources purchases Birmingham coke plant****Bluestone Resources Inc. has purchased the ERP Compliant Coke LLC plant in Birmingham, Alabama, saving hundreds of jobs.**

Bluestone is owned by the Justice family and is led by Jay Justice, son of West

Virginia Governor Jim Justice. The coke plant, which produces high-quality metallurgical coke, was in danger of closure due to a dwindling coal inventory and inoperable ovens that are necessary to manufacture coke. The plant will cele-

brate its centennial anniversary next year and is an important economic driver in the community.

**| Bluestone Resources**

**North American Stainless to modernize cold strip processing line****Andritz has received an order from North American Stainless for the renewal of cold strip line No. 1 at the Ghent, Kentucky plant.**

North American Stainless (NAS) is the largest fully integrated stainless steel produc-

er in the USA and a member of the Acerinox Group. Andritz' scope of supply and services includes engineering and delivery of a new chemical processing section, major modifications to the entry section of the line, new mist cooling section after the furnace, as well as the electrics and auto-

mation, and commissioning of the upgraded line. The modernization work is scheduled for completion in the fourth quarter of 2020.

**| Andritz**

**Nucor Steel Marion to introduce QTB process in bar mill****Following last year's order for a new 18-stand rolling mill, Nucor has now chosen Danieli to supply a new quenching and self-tempering system to be installed at the same mill in Marion, Ohio.**

The quenching and self-tempering process improves the mechanical proper-

ties, in particular the yield strength, of deformed bars produced from billets of lower alloy content. The result is a product with final technological characteristics equal to or even better than those obtained by low-alloyed/micro-alloyed steels. The new system will be designed for rolling speeds of up to 13 m/s for single and multi-strand rolling

of rebar. The QTB quenching and self-tempering unit will be controlled by a dedicated stand-alone system supplied by Danieli Automation. Commissioning is expected in the next few months.

**| Danieli**

## BANGLADESH

### BSRM Steel Mills commissions ladle furnace and continuous caster

**A 55 t ladle furnace and a three-strand billet caster supplied by Danieli have been started up at BSRM's new melt-shop in Mirsharai.**

The ladle furnace has two ladle cars positioned at 90° and a 10 MVA + 20% (overload) transformer. It is equipped with bus bar electrode arms and inert roof to minimize electrode side oxidation, slag/steel oxidation and the pick-up of oxygen, hydrogen and nitrogen in the refined and clean liquid steel.

The 3-strand 8-m-radius caster features mould-EMS for low- and medium-carbon steels, and is designed for a casting rate of 30 t/h. It produces 160-mm-square billets in open and submerged stream casting, mainly for rebar production but also for sections on the company's rolling facilities.



**I** Danieli

The new 55 t ladle furnace in operation at BSRM (Picture: Danieli)

## INDIA

### Metal granulation unit for Tata Steel Jamschedpur

**Second GRANSHOT® system at TATA Steel group**

UHT has received a second order from TATA Steel Ltd. in India for a GRANSHOT® metal granulation unit to be installed at their main integrated steel plant in Jamshedpur, Jharkhand, India. The unit will have a 300 t/hour granulation capacity to handle excess pig iron from the blast furnace operation. It will be commissioned during 2020. The first GRANSHOT order to TATA Steel Kalinganagar was commissioned in 2016.

GRANSHOT® metal granulation is an industrial and high capacity solution to solidify metal. Granulated Pig Iron, GPI, is a clean, homogenous and easy to handle modern iron product that melts rapidly in any downstream melting process. Tata Steel sells GPI under the registered trademark Tata Ferrosshots®.



**I** UHT– Uvån Hagfors Teknologi AB, Kista, Sweden

The second GRANSHOT® metal granulation unit in the TATA group will be installed at the Jamshedpur iron and steel works (Picture: UHT)



## JAPAN

### Tokyo Steel to install automatic scrap classification system

**To support scrap handling and classification of the incoming scrap material, Tokyo Steel has selected Danieli Automation to supply its Q-ASC automatic scrap classification system.**

The project will be implemented at the Kyushu plant but the cloud-based system

architecture will make possible a seamless extension of Q-ASC to other Tokyo Steel plants. The automatic scrap classification system from Danieli Automation will go through various self-learning phases to achieve fully automatic scrap classification for the EAF melting process, providing real-time feedback for yard

operations and objective support in claims made to scrap suppliers. The Q-ASC application is a response to EAF steelmakers' need for Industry 4.0-compatible data technology.

**| Danieli**

## VIETNAM

### SMS group commissioned the first converter at Hoa Phat



**In total, the new converter shop shall produce four million tons of liquid steel per year.**

SMS group has successfully commissioned the first of four converters at Hoa Phat Group, Vietnam. The SMS group scope of supply comprises four converters, each of them with a capacity of 120 t, including converter tilt drives and the maintenance-free lamella suspension developed by SMS group as well as oxygen lance systems, sublances and relining facilities. All converters will be equipped with the dry ESP primary dust collecting system from SMS group. The converters, trunnion rings, converter tilt drives and parts of the dust collecting system are manufactured in the SMS group workshop.

The converter shop will be equipped with X-Pact® electrical and automation systems and the X-Pact® process guidance system. The X-Pact® process guidance system provides the plant with a new automation standard that ensures uninterrupted operation thanks to process-oriented operator guidance. The new oxygen steelmaking plant is part of an expansion programme being realized in the Dung Quat economic zone close to Da Nang.

**| SMS group**

Converter platform at Hoa Phat (Picture: SMS group)

### Tung Ho to upgrade rolling mill

**Tung Ho Steel has chosen Danieli to upgrade its 600,000 t/year flexible rolling mill in Phu My.**

The order is for an in-line water quenching system for 10 to 43 mm straight rebars,

including detail engineering of the piping and cabling, supply of the mechanical and electrical equipment supply, and advisory services. Quenching will optimize the alloying elements in the rebar products, achieving high yield strength, very good weldability

and improved elongation. Installation and start-up are scheduled for the 2019 end-of-the-year shutdown.

**| Danieli**

## CHINA

**Baowu Steel secures medium term coking coal supply****Mechel signs 1-year contract with China's largest steelmaking group**

Russian mining and metals company Mechel reports signing a major contract for coking coal supplies with Baosteel Resources which is part of China Baowu

Steel group. The new agreement is valid September 2019 to August 2020. During this time, Mechel will supply Baosteel Resources' facilities with up to 700,000 tonnes of premium-grade coking coal. According to the contract, a major part of this coal – up to 40,000

tonnes monthly – will be supplied by Yakutugol Holding Company AO. The price will be determined on a monthly basis.

■ *Mechel*

**Baosteel Zhanjiang orders slab caster and also digitalization packages, automation and electrics for the new hot strip mill****Target is to build an intelligent and the most advanced hot strip mill in the world**

Baosteel Zhanjiang, a subsidiary company of Baosteel contracted Primetals Technologies to supply digitalization packages, automation technology and electrical equipment for its new hot strip mill to be constructed in Zhanjiang, Guangdong Province in the southern part of China. The new hot strip mill is the second one to be built at Baosteel Zhanjiang. It has a rated capacity of 4.5 million t/year and will produce coil in a width range of 720 to 1,780 mm and thicknesses between 1.2 and 12.7 mm.

The implementation of an extensive package of Industry 4.0 solutions is an important step to achieve the target of building an intelligent and the most advanced hot strip mill in the world. The project is expected to be finished at the end of 2022. In addition, a cooperation agreement for the joint development of advanced Industry 4.0 solutions in hot rolling was signed.

Baoshan Iron & Steel Co Ltd. (Baosteel) is part of the newly formed China Baowu Steel Group Corp Ltd, the second largest steel producer in the world, with a production capacity of 70 million t.

**Third slab caster to produce 2.8 million t of slabs per year for demanding applications**

Baosteel Zhanjiang also placed an order for a third continuous slab caster with Primetals Technologies. The caster, CCM 3, will be set up in the production site, where Baosteel Zhanjiang already operates two slab casters supplied by Primetals Technologies since late 2015. CCM 3 will supply



**Two-strand continuous slab casters from Primetals Technologies at Baosteel Zhanjiang**  
(Picture: Primetals Technologies)

slabs for the 1,780 millimeter hot strip mill, complements the new Zhanjiang facility and is part of a second phase of site development with the aim to reach an annual steel plant capacity of 12.35 million metric tons per year. Start-up of the new casting machine is expected for early 2021.

The continuous slab caster CCM 3 is similar to the previously supplied casting machines CCM 1 and CCM 2, allowing for interchangeability of equipment and employing the same automation concept and configuration, as well as the same operation and maintenance procedures. It is designed as a bow type caster with straight

mold, a machine radius of 9.5 meters and a metallurgical length of 37.2 meters. It produces slabs in widths from 900 to 1,650 millimeters and thicknesses of 230 or 250 millimeters. The casting speed can be varied between 1 and 1.95 meters per minute. Steel grades to be produced include the whole spectrum of carbon steel, from ultra-low to high carbon, deep-drawing, structural, peritectic and HSLA grades, micro alloyed to high alloyed steels, as well as pipe, strip and silicon grades.

■ *Primetals Technologies*



## CHINA

## Fujian Tsing Tuo commissions high-speed wire rod finishing end



The laying head is equipped with oil-film bearings (Picture: Danieli)

**The new 10-pass fast-finishing block, supplied by Danieli has been successfully started up at Fujian Tsing Tuo.**

The state-of-the-art finishing equipment for two wire rod rolling mills, including a 10-pass fast-finishing block, is characterized by easy ring changing, extreme rigidity, minimum vibrations, high-speed design and high rolling quality. A laying head equipped with innovative oil-film bearing rotors reduces vibrations and noise generation, and guarantees better wire rod patterns and increased pipe life-time. The product range covers wire rods from 5.5 to 20 mm. Speeds of up to 105 m/s achieve maximum production rates of 110 t/h.

**Danieli**

## Fuxin Special Steel orders coil handling system

**Stainless steel producer Fuxin Special Steel Co., Ltd., based in Zhangzhou in the province of Fujian, and part of Formosa Plastics Corporation, has placed an order with Amova, a company of SMS group, for the supply of a coil logistics system.**

Fuxin Special Steel is going to expand its production facilities by a new hot rolling mill and cold rolling mills, including a con-

tinuous annealing and numerous finishing lines. The logistics concept covers all coil transport facilities from the hot rolling mill exit end via several coil preparation stations and three cold rolling mills to the continuous annealing line, further via finishing lines to the high-bay store for shipment. Connection of the hot rolling area to the cold rolling mill area will be via a curved tunnel 9 m deep and 120 m long. In the

cold rolling area, the hot-rolled stainless steel coils – with a maximum weight of 28 t – will be distributed by means of two 600-m-long rail lines with three and four high-speed cars, respectively, designed for automatic coil pick-up and positioning. About 750 saddle-type coil rests will be arranged along the two transport routes for interim coil storage. All transport functions will be managed and controlled by a warehouse management system.

Fuxin Special Steel had awarded the process line contracts to different manufacturers prior to selecting the coil logistics supplier, confronting Amova with the challenge of considering completely different interfaces for the coil transport system. In addition to the coil logistics, Amova is to supply platform cars for the cross transport between the individual bays of rolls, coils and packaging material.

The complete plant is scheduled to be commissioned in mid-2021.

**Amova**



**High-speed coil transfer car of the type to be supplied to Fuxin (Picture: Amova)**



## CHINA

## HBIS ShiSteel to install eco-friendly reheating furnace

**Chinese steelmakers are committed to choosing green technologies for non-polluting performance**

Shijiazhuang Iron & Steel Company within China's HBIS Group signed a contract with Fives for the delivery of two reheating furnaces, each with a production capacity of 130 tons per hour. The ultimate choice was Stein Digit@I Furnace® due to its green performance. This walking beam furnace, operating on natural gas, is equipped with patented wide flame burners and a combustion system with individual on/off control. The wide flame burners improve the crosswise and lengthways temperature profiles of the products, while the individual on-off control allows high thermal efficiency while reducing fuel consumption and NO<sub>x</sub> emissions. HBIS ShiSteel is now relocating its steelmaking facilities 80 kilometers away from Shijiazhuang city to set up new standards for cleaner, more flexible and more efficient steelmaking in China.



Stein Digit@I Furnace® (Picture: Fives)

The scope of the project on EPC basis includes engineering, equipment supply, erection and commissioning, which will be completely executed by Fives Stein Met-

allurgical Technology (Shanghai), a Fives' subsidiary in China

■ Fives

## Jiangsu Lihuai Iron &amp; Steel orders KOCKS reducing and sizing block

**The company has placed an order with Friedrich KOCKS GmbH & Co KG, Hilden, Germany, for the supply of a RSB® 370++/4 in 5.0 design.**

The RSB® 370++/4 will produce straight bars within a diameter range from 20 to 65 mm and will be placed as a finishing unit after the roughing and intermediate train consisting of 16 stands in horizontal/vertical arrangement. The commis-

sioning is scheduled for the second half of 2020.

Jiangsu Lihuai Iron & Steel is a company of Huaigang Special Steel, a subsidiary of the Shagang Group, which is the 6th largest steel producer in the world and one of the largest privately owned industrial enterprises in China. The Shagang Group has altogether four steel production companies with an annual capacity of 38.5 million t in Jiangsu and Henan provinces.

With the implementation of RSB® 370++/4 in the existing bar mill line, Huaigang Special Steel intends to further increase the competitiveness among Chinese SBQ producers with economically rolled finished SBQ products of exceptionally good quality. Huaigang Special Steel is operating successfully a KOCKS block already since 2012.

■ Friedrich KOCKS GmbH & Co KG

## First heat at Chongqing Kingsley Titanium

**This project represents the first successful commissioning of an INTECO TI-VAR furnace in China.**

The Chinese steel producer Chongqing Kingsley Titanium Technology awarded INTECO with the engineering and supply of a Titan vacuum arc remelting plant (Ti-VAR), with which ingots with an approximately weight of 17 t and a diameter of 1,200 mm can be remelted in one melt station. After the on schedule delivery beginning of 2019 and the erection finalized this spring, now and very much to the

pleasure of the client and the INTECO expert time on site the first heat was carried out successfully.

The remelted ingot was produced with the so called "double-stick" method, where one long electrode is welded out of two smaller ones. First the stub is welded with the consumable part and then the second electrode is welded with the first one in the furnace according to predefined process parameters.

■ INTECO



First remelted ingot at the new Ti-VAR plant at Chongqing Kingsley Titanium (Picture: INTECO)



## CHINA

## Sanming to modernize SBQ bar mill line

**Fujian Sangang Minguang Group Co. Ltd. (Sanming) has placed an order through the Chinese EPC contractor Capital Engineering & Research Inc. Ltd. (CERI) with Friedrich KOCKS GmbH & Co KG, Hilden, Germany, for the supply of a RSB® 370++/4 in 5.0 design.**

Sanming is a state-owned enterprise, founded in 1958 and is the most important steel producer in Fujian province with approximately 11 million annual tons of

steel. The RSB® 370++/4 is the key component of an extensive modernization project of the locally manufactured bar mill line, targeting to further improve the finished quality of Sanming's SBQ products.

The large modernisation scale of the EPC contractor includes furthermore the supply of H/V stands, shears, a new bar in coil line with finishing facilities, the upgrade of the inspection line, civil works and the electric and automation of the mechanical equipment.

The RSB® 370++/4 will be located as a finishing unit after the roughing and intermediate train consisting of 21 stands in horizontal/vertical arrangements and will produce bar in coil with a diameter range from 16 to 48 mm and straight bars within a dimension of dia. 20 to 90 mm. The commissioning is scheduled for the second half of 2020.

**Friedrich KOCKS GmbH & Co KG**

## Shagang orders grinders for special steel billets

**Danieli Centro Maskin is going to supply two billet grinding units to the Shagang group.**

The two billet grinders of Danieli's HiGrind technology will process 140 and 150 mm

billets up to 16 m long at the Shagang mill, at a throughput of over 100,000 t/year. The grinders will be manufactured at Danieli China in Changsu, including all handling equipment, hydraulics, secondary filtering equipment. Electrics and automa-

tion will be supplied by Danieli Automation. Installation of the grinders is scheduled for spring 2020.

**Danieli**

## CHINA/TAIWAN

## China Steel Corporation orders three 160-t converters

**Improved plant availability and less maintenance**

China Steel Corporation (CSC), Taiwan, has awarded SMS group the contract to supply three 160-ton converters for its No. 1 steel making plant in Kaohsiung, Taiwan. The aim of the upgrade is to improve the availability of the converters and reduce

the need for maintenance. Replacement of the old and commissioning of the three new converters are scheduled for the period 2020 to 2022.

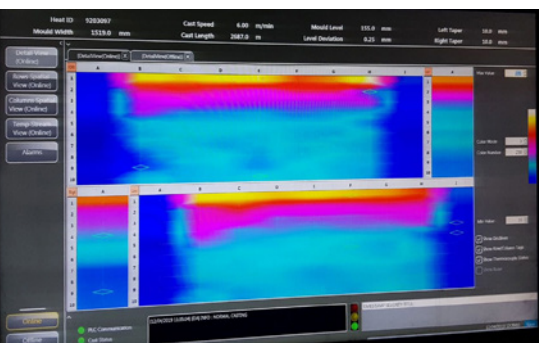
The scope of supply covers the converter vessels, the trunnion rings, the proven lamella-type vessel suspension system, the tilt drives, the X-Pact® electrical and automation systems for the tilt drives, and

supervision of erection and commissioning.

SMS group will ship the trunnion rings of 9-meter-diameter each in one piece to the customer's site in Taiwan, considerably reducing the overall installation time.

**SMS group**

## Tangshan starts up mould electro-magnetic braking system on thin-slab casters



**Visualization of the mould status during thin-slab casting** (Picture: Danieli)

**Tangshan Iron and Steel (TISCO) has had its two thin-slab casters upgraded after seven years of operation. Danieli carried out the upgrades on the two thin-slab casters it had supplied in 2012.**

For the upgrade, Tangshan ordered Danieli Rotelec mould electromagnetic brake technology (MM-EMB®) to assure production of defect-free thin slabs at high speeds and throughput. This technology uses five electromag-

nets to produce a static permanent magnetic field across the mould, to generate stabilizing and damping effects, in addition to braking. Only five days after the first heat was produced with the MM-EMB® in operation, a casting speed of 6.0 m/min on a medium-carbon steel grade was achieved, with excellent hot-rolled coil quality results.

**Danieli**

## CHINA

### Valin Xiangtan starts up bloom caster

**Valin Xiangtan has successfully started up its new, five-strand bloom caster, less than 13 months from the contract signing with Danieli.**

The caster operates with different withdrawal units along the line performing simultaneous soft and hard reduction, to further optimize internal quality, particularly with high-carbon grades which tend to exhibit higher porosity and segregation. Immediately after the start-up the caster successfully produced a wide range of steel grades, including high-alloyed and high-carbon spring steels in square and rectangular sections, 280 mm x 280 mm and 350 mm x 430 mm.



The Valin and Danieli site teams erected the machine in just 38 days, limiting the cold tests to just 11 days (Picture: Danieli)

**I** Danieli

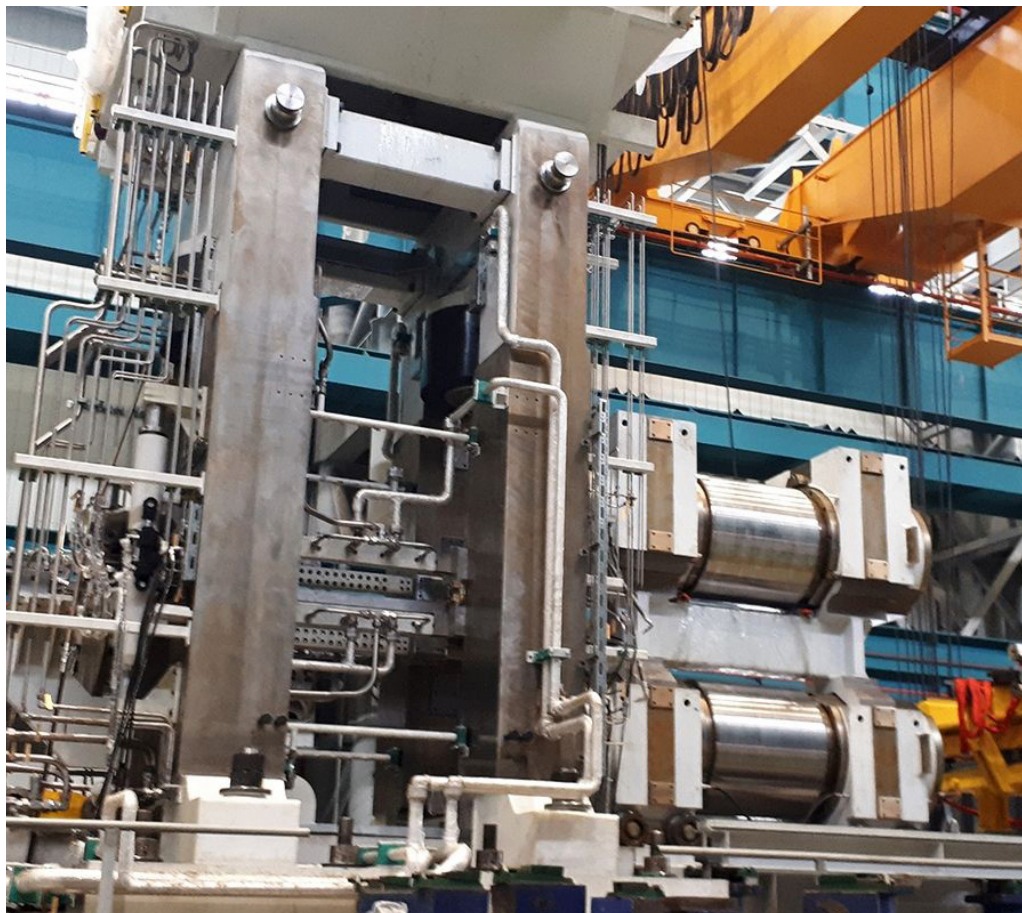
### Waelzholz New Material builds new cold rolling mill

**Danieli Fröhling is building a new 4-high cold rolling mill for Waelzholz New Material in Taicang, Jiangsu province.**

The new cold reversing mill is designed to roll a wide product mix of special steel grades, from an entry thickness of more than 5 mm down to a finish thickness of below 1 mm at a maximum strip width of 670 mm. The mill can also be operated in skin-pass mode. It will be equipped with independently driven, twin-drive work rolls, and high-torque drive spindles.

Danieli Automation will supply the electrical and automation systems. An intelligent data analysis system, ready for Industry 4.0, will be connected to the Wälzholz proprietary process data management system.

Danieli is responsible for the supply of the complete equipment on a turn-key basis, from design and manufacturing up to and including all erection and commissioning activities. The project is lead by Danieli Fröhling, in close collaboration with the Wälzholz headquarters in Germany. The cooperation is planned to be extended beyond the final plant acceptance, aiming at long-term process enhancement support and service.



The mill housings of the new 4-high cold rolling mill installed at Waelzholz New Material in Taicang (Picture: Danieli)

**I** Danieli



## CHINA

## New high-speed open-die forging press in operation at Western Superconducting Technologies

### Expansion of production capacity and forging capabilities

Western Superconducting Technologies Co. Ltd., (WST), headquartered in Xian, in Shaanxi Province, China, has successfully put into service a 63/80-MN two-column high-speed push-down open-die forging press supplied by SMS group. The supply also included two integrated railbound 25-t manipulators and a mobile eight-ton loading and unloading manipulator. The Chinese company is now able to flexibly manufacture various high-quality products for its customers from the aerospace industry, for example. The new high-speed press forges extremely precisely and reliably, with a maximum press force of 63 MN and an upsetting force of 80 MN. Thanks to the advanced hydraulic and control systems installed, the new open-die forging press forges highly demanding and temperature-sensitive materials such as titanium and titanium alloys in a technologically perfect way. The two integrated railbound forging



The new 63/80-MN high-speed open-die forging press in operation at WST (Picture: SMS group)

manipulators handle the forgings weighing up to 25 t accurately to the millimeter and perfectly synchronously with the press stroke, even at very high stroke rates. The double rail-bound manipulators

enable WST to boost their throughput of forgings.

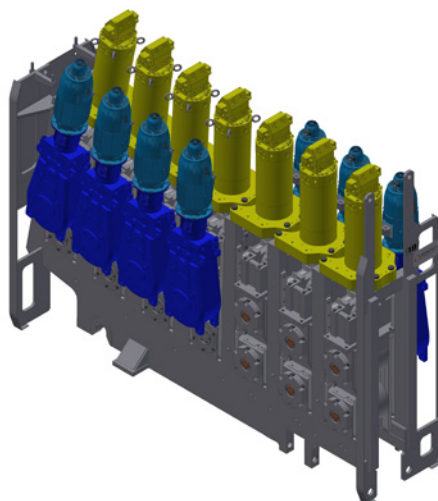
■ SMS group

## Zenith Steel modernizes 10-strand billet caster

### World's first application of Single-Roll DynaGap segments in a billet caster

Zenith Steel Group Co., Ltd. awarded an order to Primetals Technologies to modernize a 10-strand billet caster in its converter steel making plant No. 3 in Changzhou. The billet caster will be the first one worldwide to be equipped with the new SRD (Single-Roll DynaGap) segments. The SRD segment has been specially developed for use in the area of final solidification, and it enables the upper rolls to be pressed down individually onto the solidifying strand. This enables the final solidification point to be followed precisely. Technological packages like DynaPhase, Dynacs 3D and DynaGap SoftReduction 3D will further improve the internal billet quality with regard to center porosity and center segregation. Start-up of the modernized casting machine is expected for March 2020.

The 10-strand billet caster of Zenith Steel in its Changzhou, Jiangsu Province plant has a rated capacity of 2 million metric tons per



3-D scheme of the withdrawal unit with SRD segments for hard reduction (Picture: Primetals Technologies)

year. It produces sections with a cross section of 160 mm x 160 mm at a maximum casting speed of 2.4 meters per minute. Steel grades processed include low, medium

and high carbon steels as well as tube, spring, cold heading and tyre cord steels.

■ Primetals Technologies

## CROATIA

### ABS Sisak reports improved performance after EAF upgrade

**The Q-One power system installed by Danieli Automation at the ABS Sisak special steel meltshop has increased the active power availability and efficiency of the electric arc furnace.**

The upgrade of the 78 t melting unit by installing the Danieli Digimelter melt-

ing tool and the Q-One power system at ABS Sisak has led to a 20% reduction of electrode consumption and a 10% shorter power-on time. The technology achieves very low network flicker due to a quick control of voltage and current, and a power factor constantly above 0.96. One of the targets

of the upgrade at ABS Sisak was to comply with the stricter rules applied by the Croatian electrical energy supplier.

**| Danieli**

## CZECH REPUBLIC

### Trinec Iron & Steel to implement liquid pool control model in long products casting

**Danieli Automation has supplied its 3Q LPC model to Trinec Iron & Steel, which is used to estimate the casting product temperatures for two of its continuous casting machines.**

The 3Q LPC off-line, liquid pool control model is a real-time mathematical mod-

el that estimates product temperatures in continuous casting machines. The model simulates the steel temperatures during casting by setting several process variables, including the steel grade and product dimensions, for example. The main information provided by the model is temperature distri-

bution along the strand and the solid/liquid fraction distribution along the strand.

**| Danieli**

### Trinec Iron & Steel to modernize blast furnace No. 6 in 2021

**Czech steel company awards BF hearth reline to Paul Wurth**

Trinec Iron & Steel – an integrated steel works located in the very North-East of the Czech Republic – trusts in joint hearth condition assessment and relies on Paul Wurth's engineers' expertise and technology for adopting lifetime and campaign strategy for his two blast furnaces. In late spring 2019, the company has awarded a contract to the Paul Wurth group for the complete reline of No. 6 blast furnace's hearth. The project includes basic and detail engineering for the new hearth and the supply of all refractory materials. On top of the refractory engineering and deliveries, Paul Wurth will be responsible for all site activities such as salamander tapping, removal of residual hot solid material, demolition of the old hearth, assembly of the new hearth as well as the corresponding site management and supervision.

This hearth of BF6 has been in operation for more than 20 years by now and will reach a campaign of 22 years when the reline will start in 2021. Already in the offer phase, Paul Wurth has advised over a longer period on possible campaign extension measures and reline

techniques. This included assessment of the status of No. 6 BF's hearth by application of multipoint thermocouple sensor probes (MTP probes) installed in two steps in 2017 and 2018.

Trinec Iron & Steel produces added value products such as rails, sections, steel wire and bar, seamless tubes as well as special steel for tools and springs. The whole production bases on an ironmaking plant consisting of two blast furnaces of nearly equal design, with a joint capacity of just a little bit more than 2 million tons of hot metal per year.

**| Paul Wurth**



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## GERMANY

### thyssenkrupp Rasselstein to install new chromium plating line

**thyssenkrupp Rasselstein GmbH has ordered a chromium plating line from Andritz for its Andernach plant.**

The scope of supply and services includes engineering, manufacture and supply of the mechanical, process engineering and electrical equipment, and erection work and start-up of the line. Production of the

first coil is scheduled for the first quarter of 2022.

The chromium plating line to be supplied will comply with the new EU directives (chromium6+ ban by the EU chemicals directive REACH). The process used in the new plant – known as TCCT Trivalent Chromium Coating Technology – for chromium plating of packaging steel uses triva-

lent chromium for surface treatment, thus meeting the REACH requirements. thyssenkrupp Rasselstein produces tin-plated or electrolytic chromium coated packaging steel from cold-rolled sheet steel in thicknesses from 0.100 to 0.499 mm.

**I Andritz**

### Salzgitter Flachstahl to modernize continuous slab caster

**Upgrading the plant with trendsetting features, including hydraulic resonance oscillator and the digital alignment**

Salzgitter Flachstahl has awarded SMS group the order to modernize the continuous slab caster No. 1 at its Salzgitter works. The plant, which was delivered by SMS group in 1981, is to be fitted with a new machine head with mould,

oscillator, and segment 0. The plant shall be upgraded with a range of trendsetting features, including the use of a hydraulic resonance oscillator and the digital alignment assistant HD LASr [mold]. The modernization project is set to take place during a scheduled plant shutdown in October 2020.

Salzgitter Flachstahl GmbH produces around 4.7 million tons of steel every

year in its integrated iron and steel works and its 4 continuous slab casters. The portfolio of advanced grades includes thin sheet (ULC and LC), strength grades up to microalloyed tube steels, for example API X70/X80, and carbon steels up to C 80.

**I SMS group**

### thyssenkrupp Steel completes clean air project at the sinter plant

**The third fabric filter unit is taking shape in Duisburg**

thyssenkrupp Steel has invested a total of around €100 million in a fabric filter project at its Duisburg site to clean the air from the sinter plant. The last of three fabric filters is scheduled to go into operation in spring 2020. In the course of the project another 17-t section of the filter has now been moved into position.

The sinter plant in the north of Duisburg consists of three belts. Electrostatic pre-

cipitators usually collect most of this dust, but thyssenkrupp is setting new standards in air cleaning with its large fabric filters and collecting even the smallest dust particles. Initially, a first fabric filter was installed at the smallest sinter belt in 2011. Second, the filter unit on the largest of the three belts was commissioned in 2017. Now it's time for belt number three. "The fabric filter system in Duisburg is amongst the biggest and most effective of its kind in the world," says project manager Tibor Hänsel. "One of our biggest ever projects

for clean air will finally be successfully completed in a few months' time." The investments are paying off. The filters capture 99.9% of dust emissions and thus significantly improve the air quality around the sinter plant. This is also an important contribution to the environment in the Ruhr region and a clear commitment to the Duisburg production site of the company.

**I thyssenkrupp Steel Europe AG**

## POLAND

### AOD converter commenced operation at PIOMA Odlewnia



#### New area of metallurgical possibilities

In April 2019 UHT has started up an AOD converter refining plant for the foundry company PGO S.A., Poland at their plant

**Pulpit of the new AOD converter refining plant at PIOMA Odlewnia (Picture: UHT)**

PIOMA Odlewnia in Piotrków Trybunalski, south west of Warsaw. The AOD has a 7 tonnes capacity as to produce special and stainless steel grades needed for their foundry products. The project was realised as a turnkey project by UHT

which included civil works, rooms and fume treatment plant. The AOD converter is equipped with the UTCAS® level 2 process control system. The new plant enables PIOMA Odlewnia to apply secondary metallurgical processes and

hence produce higher quality of cast steel.

■ *UHT– Uvå Hagfors Teknologi AB, Kista, Sweden*

## RUSSIA

### Mechel signs major contract for coke and coal

#### International trading company Steel Mont secures stock

Mechel reports signing a major contract for coke and coal supplies with the international trading company Steel Mont. According to the agreement, before the end of 2020 Mechel will sup-

ply Steel Mont with up to 700,000 tonnes of products, including up to 350,000 tonnes of metallurgical coke produced by Moscow Coke and Gas Plant and up to 350,000 tonnes of pulverized coal (PCI) and anthracites produced by Southern Kuzbass Coal Company. The supplies will be shipped by

sea through Port Mechel-Temryuk (Sea of Azov) in Krasnodar Region in Southern Russia as well as Russian ports in the North and Baltic Seas.

■ *Mechel*

### NLMK orders bell annealing furnaces

#### Danieli Centro Combustion will supply a bell annealing furnace installation to NLMK Metiz for the Berezovki facility.

The new system will heat-treat (recrystallize) steel wire coils in 100% N<sub>2</sub> atmosphere. The furnace can be charged with 21 t coils in seven stacks of three coils each. The project consists of two phases. In each phase, Danieli Centro Combustion will supply two bases, one heating hood, two inner covers, and one cooling hood. The furnaces will have a direct coupled base fan, a diffuser and plenum, hydraulic locking system and sili-



Key equipment of the bell annealing facility for steel wire coils (Picture: Danieli)

con-carbide head burners, each with its own recuperator. Danieli will supply all mechanical, electrical and automation equipment, and provide technical

assistance during erection and commissioning.

■ *Danieli*

### Severstal places order for extensive plate mill

#### Danieli has been awarded a contract by Severstal for the upgrade of plate mill 2800 at Cherepovets.

The purpose of the upgrade is to improve the plate surface quality and increase the production volume. The order for Danieli includes a new hot dividing shear, two new, disc-type cooling beds, an upgrade to the plate tilter for plate inspection, two chain transfers, and new piling facilities con-

sisting of over 3,000 t of new equipment.

The fully hydraulic hot dividing shear will be able to cut plates with thicknesses up to 50 mm, at temperatures up to 1,000°C. The shear will be shiftable offline when not in use to protect it from extended exposition to high temperatures. The new pair of cooling beds will assure the requested surface quality of the plates thanks to the disc-type design. Danieli Automation will

provide new Level 1 and Level 2 automation systems for the supplied equipment, including a crop optimization system for the hot dividing shear. The project will be carried out in several steps, with project completion scheduled for spring 2021.

■ *Danieli*



## SWEDEN

### Uddeholm chose UTCAS® for steel plant control

**Uddeholm has ordered a new automation system that will handle the control of all steelworks processes including the electric arc furnace, ladle furnace and vacuum furnace.**

The delivery is based on UHT's level 2 platform UTCAS® for design, control and optimisation of processes and equipment in

steelworks. Also included in the delivery are adaptations to support Uddeholm's unique manufacturing processes of their world-leading tool steels and high-performance steels.

The new system will be in operation in the first quarter of 2020. With UTCAS®, Uddeholm will take further steps towards Industry 4.0 in their steel

production and get access to a scalable platform with support for the increasingly automated and connected production of the future. The installation of UTCAS® will also be an advanced tool for process development.

■ *UHT Uvån Hagfors Teknologi AB, Kista, Sweden*



The level 2 system UTCAS® will implemented to control the EAF, LF and VD at Uddeholm steel plant (Picture: UHT)

## TURKEY

### Çolakoglu to convert VD to VOD plant

**Heat size of 295 t will make the VOD plant largest in the world**

Turkish steelmaker Çolakoglu Metalurji A.S. (Çolakoglu) has placed an order with Primetals Technologies to upgrade an existing VD (Vacuum Degassing) plant in

its Dilovası meltshop to a VOD (Vacuum Oxygen Decarburization) plant. With a heat size of 295 metric tons, the VOD plant will be the largest worldwide. The aim of the modernization project is to enable the production of special steels, like IF grades, ULC grades or stainless steels. This will

help Çolakoglu to broaden its product range and enter additional markets. The VOD plant is expected to be operational in March 2020.

■ *Primetals Technologies*

## UKRAINE

### Centravis revamps extrusion line runout

**Centravis has contracted Danieli Breda to revamp the runout system of its extrusion line.**

Centravis produces extruded specialty steel pipe for the local market. For this pro-

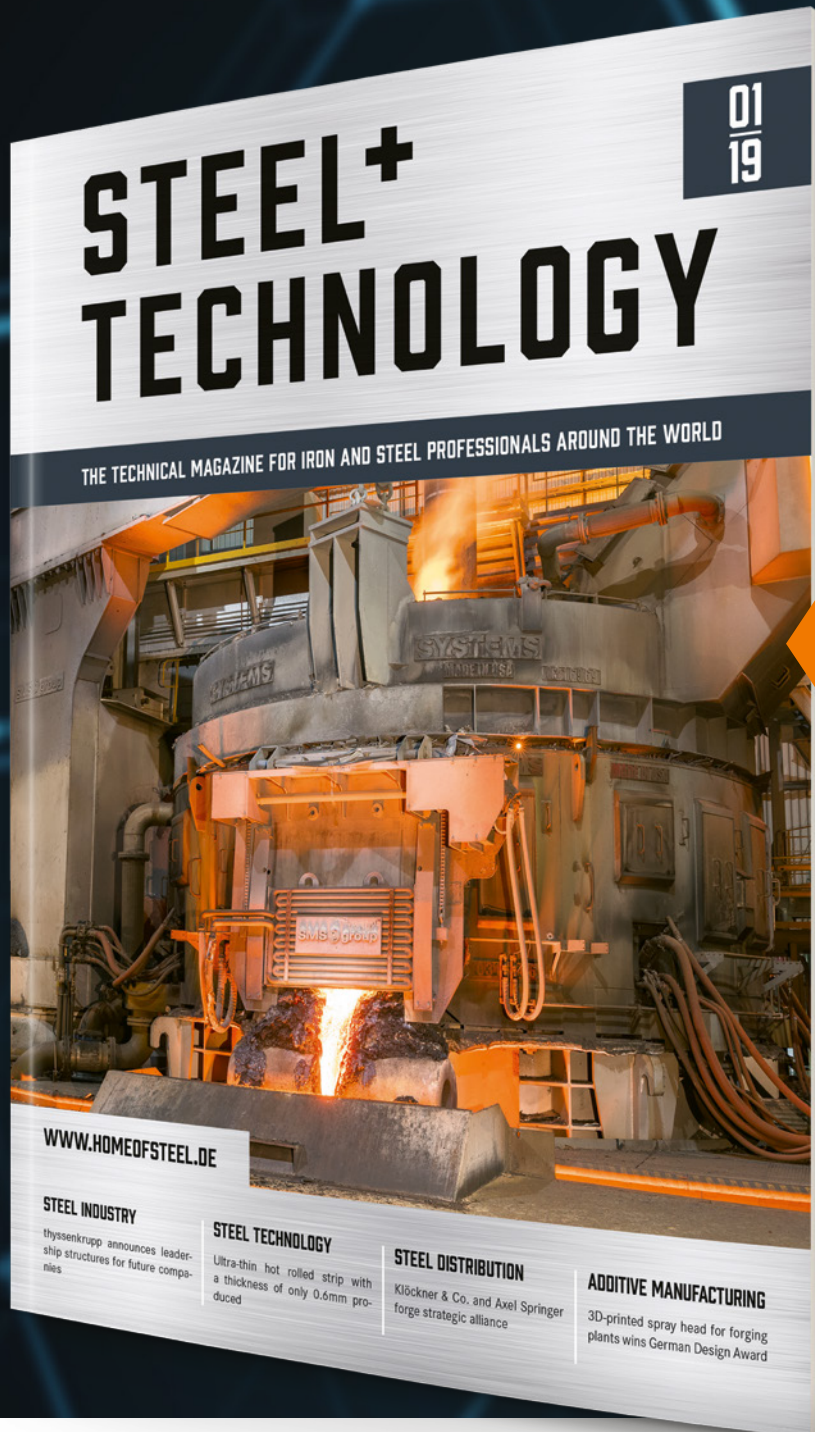
ject, Danieli has custom-engineered a new cooling system equipped with double cooling stations, visual inspection and a tank bypass system, plus scrap glass recovery tools. The new runout concept has been developed with a view to improving the

metallurgical quality of the pipes, reduce process inconsistency and increase plant availability. Delivery is scheduled for 2020.

■ *Danieli*

The new technical journal

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Top-level panel discussion marked the highlight at the premier HÜTTENTAG conference (Picture: Messe Essen/Rainer Schimm)

## Inauguration of a new steel conference and exhibition

# Successful premiere of Germany's new premier annual steel event HÜTTENTAG

Keynotes, panel discussions and specialist lectures addressed current challenges in the steel industry and introduced solutions

More than 400 participants, more than 30 exhibitors, current topics in the steel industry and a lively exchange of professional ideas marked the inauguration of the HÜTTENTAG 2019, which was held under the motto "Preserving tradition. Shaping the Future" in the new East Foyer of Messe Essen. DVS Media GmbH and Messe Essen GmbH as joint organisers are delighted about the successful debut event.

"The intensive professional exchange throughout the day shows us that we have hit the right nerve for the industry with our event concept of keynotes, panel discussion, specialist lectures and accompanying company exhibition", says Dirk Sieben, Managing Director of DVS Media GmbH. "The steel industry is facing major challenges," says Oliver P. Kuhrt, Managing Director of Messe Essen GmbH. "With the HÜTTENTAG we offer a platform to discuss these challenges and to find solutions.

**The intensive professional exchange throughout the day shows us that we have hit the right nerve for the industry with our event concept of keynotes, panel discussion, specialist lectures and accompanying company exhibition**

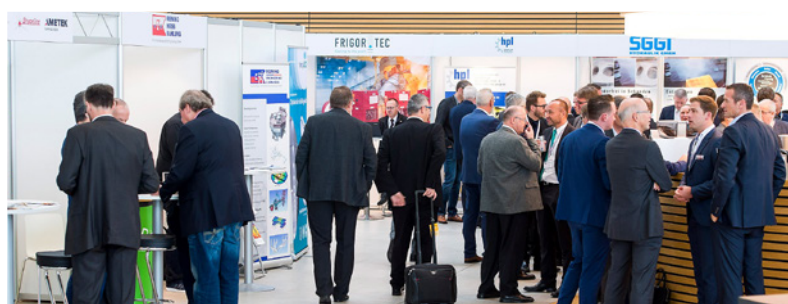
*Dirk Sieben, Managing Director, DVS Media GmbH, Düsseldorf, Germany*

Essen's 1st City Mayor Rudolf Jelinek also stressed the unbroken importance of the German steel industry in his welcoming address: "Germany is the largest steel producer in the EU and the seventh largest steel producer in the world. The steel industry is still the backbone of the German economy". In his view, the fact that the new HÜTTENTAG will make Essen a meeting place for the sector fits the region perfectly: "In the last 100 years – apart from the coal mines – no other industry has shaped the Ruhrgebiet more than the steel industry. In addition to CO<sub>2</sub>-free steel production, the main topics at HÜT-

TENTAG 2019 included additive manufacturing, digitization and e-mobility. In addition, new production potential, aspects of plant construction, technology know-how transfer and other current issues were discussed in numerous lectures. At the concluding social event in the evening, there was ample time to continue the discussions and network with new contacts in the industry. The next HÜTTENTAG will take place on 5 November 2020 at the Congress Center Ost at Messe Essen.

*Further information can be found at [www.homeofsteel.de](http://www.homeofsteel.de)*





# Impressions from the HÜTTENTAG

All photos: © Messe Essen GmbH/Rainer Schimm







# HÜTTENTAG 2019

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## Short range outlook for global steel demand

# Global steel demand remains resilient despite an uncertain economic environment

The World Steel Association (worldsteel) released its short range outlook for 2019 and 2020. The global steel demand remains resilient despite an uncertain global economic environment, driven by developing and emerging economies. Chinese steel demand shows a high growth in 2019 owing to a strong real estate sector, but may slow down in 2020. Steel demand in the developed world stagnates with weakening manufacturing. Developing economies (excluding China) present a mixed picture, but high growth is expected in Asia.

On the occasion of their general assembly in Monterrey, Mexico, on 14 October 2019, the World Steel Association (worldsteel) released its short range outlook for the years 2019 and 2020. In 2019 worldsteel forecasts that steel demand in China will grow by 7.8% to reach 900.1 million t and the rest of the world is expected to record 0.2% growth to 874.9 million t. In 2020, Chinese steel demand is expected to grow by 1.0%, whereas steel demand in the rest of the world will grow by 2.5%, driven by 4.1% growth in the emerging and developing economies excluding China.

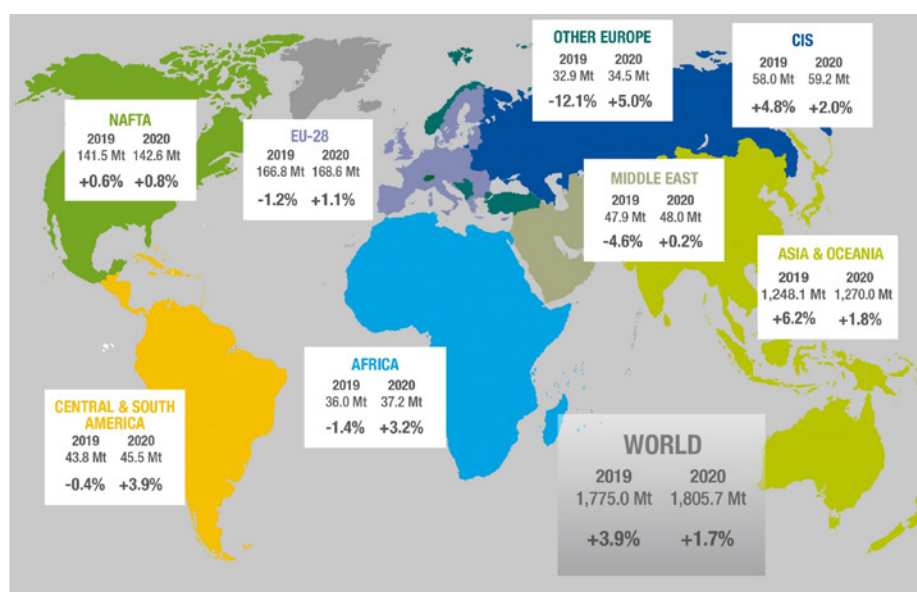
**Global steel demand** will grow by 3.9% to 1,775.0 million t in 2019 and will grow by another 1.7% in 2020, reaching 1,805.7 million t. Global steel demand remains resilient despite an uncertain global economic environment, driven by developing and emerging economies. Commenting on the outlook, Mr Al Remeithi, Chairman of the worldsteel Economics Committee said, "The current short range outlook suggests that global steel demand will continue to grow in 2019, more than we expected in these challenging times, mainly due to China. In the rest of the world, steel demand slowed in 2019 as uncertainty, trade tensions and geopolitical issues weighed on investment and trade. Manufacturing, particularly the auto industry, has performed poorly contracting in many countries, however in construction, despite some slowing, a positive momentum has been maintained. While the global economic outlook is highly unpredictable, we expect to see further growth in steel demand in 2020 of 1.7%, with emerging and developing economies excluding China contributing

more. This forecast faces significant downside risks if the current level of uncertainty prevails."

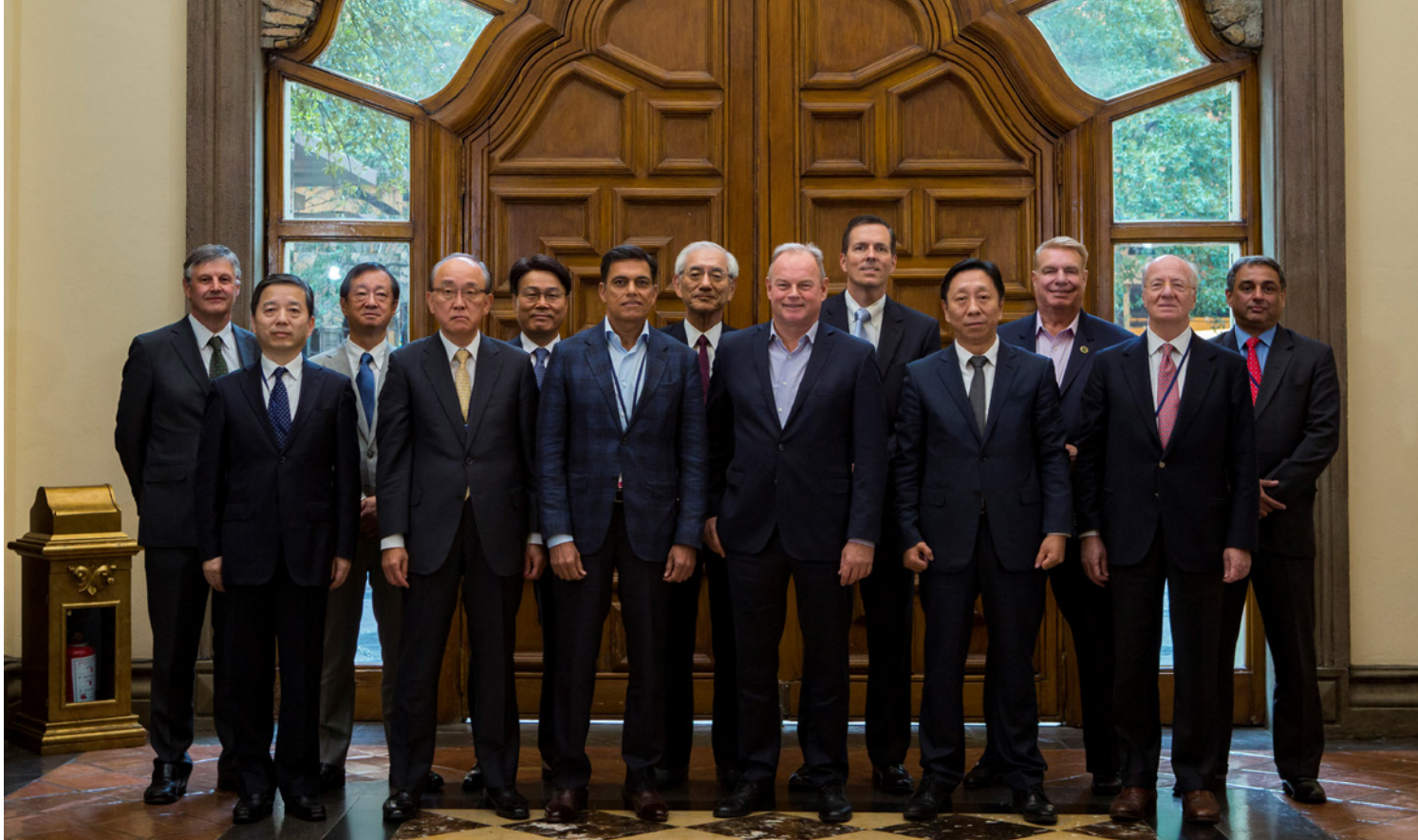
**Chinese steel demand** is showing high growth in 2019 owing to a strong real estate sector, but is forecasted to slow down in 2020. While the Chinese economy continued to decelerate and is expected to record its lowest GDP growth since 1992, steel demand is still expected to grow by 7.8% in 2019, largely driven by real estate investment. In the first seven months of 2019 China's real estate market reported the strongest performance over the same period for the last five years. Firstly, due to the relaxation of control policies in tier 2 to tier 4 cities and secondly the newly implemented construction standard, put into effect in April 2019, estimated to have increased steel intensity in

new buildings by about 5.0%. Conversely, China's manufacturing sector is experiencing a significant slump due to the slowing economy and the effect of trade tensions. The Chinese automotive industry has contracted for 13 months in a row.

worldsteel expects the Chinese economy to worsen in the later part of 2019 and in 2020 with the unresolved trade tensions adding further pressure. It is unlikely that the Chinese government will reintroduce substantial stimulus measures as it continues to hold a balance between containing the slowdown and pushing forward its economic restructuring agenda. Selective mild stimuli focused on infrastructure and strengthening consumer purchasing power through tax cuts is more likely. The auto industry could benefit from such stimulus in 2020. China's steel demand is expected to see growth of 1.0% in 2020.



Steel demand, finished steel, Mt = million t, y-o-y growth rate in % (Picture: worldsteel)



Executive committee meeting, general assembly 2019 (Picture: worldsteel)

**Steel demand in the developed world** stagnates with weakening manufacturing. After growing by 1.2% in 2018, steel demand in the developed economies is expected to show a small contraction of -0.1% in 2019. The consumer sectors and construction maintained positive momentum, however manufacturing slumped due to a deteriorating environment for export and investment. In 2020, with the effect of some technical rebound, steel demand in the developed world is expected to grow by 0.6%.

**Developing economies** (excluding China) present a mixed picture, but high growth is expected in Asia. Growth of steel demand in the emerging economies excluding China is expected to slow down to 0.4% in 2019 due to contractions in Turkey, MENA and Latin America. But the growth is expected to rebound to 4.1% in 2020 due to infrastructure investments, especially in Asia.

## Construction

The global construction sector's growth is expected to slow to 1.5% in 2019 and 1.2% in 2020 after growth of 2.8% in 2018. The picture for construction activity in the developed economies in 2019-2020 is somewhat mixed. The US construction sector is expected to weaken in 2019 with no recovery in 2020. In Europe, the con-

struction sectors in Germany, Spain, the Netherlands and Central European economies, while still maintaining growth, will slow down due to weakening economic fundamentals and constraints in construction capacity. Civil engineering is expected to be the construction driver owing to investment in energy, transport and communication networks.

The Japanese construction sector is projected to report almost no growth as the decline in residential construction will be offset by growth in civil engineering. Korea's construction sector is expected to continue contracting despite some support from public projects.

Construction in emerging markets will be strong, largely influenced by infrastructure projects. In China, the real estate sector drove growth in construction activity in 2019, but in 2020 this will slow down. Infrastructure investment is expected to be boosted by government stimulus. In ASEAN and India, active infrastructure investment is expected to drive construction.

Turkey has seen contracting construction activity in line with the overall economy. After a severe decline in 2019, Turkey will see only a moderate rebound in 2020.

In Latin America generally, infrastructure investment is constrained by uncertainty and government budget issues. Brazil's construction sector, which has been contracting since 2014, has shown

positive growth in 2019 and this could continue with infrastructure a policy priority.

## Automotive

Global automotive production decelerated in 2018 and is expected to contract in 2019 with recession deepening and broadening across several major markets including Germany, Turkey, China and South Korea. The automotive market has been hit by more than global economic factors including, market saturation, reduction in purchasing and promotion incentives and most importantly customer hesitancy during the transition of the auto industry from combustion engine-powered via hybrid to fully electric vehicles.

This decline has been particularly severe in Germany and China with passenger car production declining by -10.6% and -13.8%, respectively in the first eight months of 2019. It is expected that the Chinese government may introduce some tax measures to boost sales of passenger vehicles, especially new energy vehicles. This could lead to a recovery in 2020.

In the US, the auto market is expected to decelerate with no growth in 2019 and only a slight increase in 2020, but steel use is expected to benefit from the shift toward light truck models. Japanese and Korean car production is being affected by weak export markets.



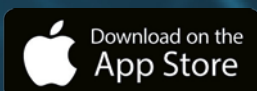
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The Indian automotive industry suffered from the liquidity crisis and weak global demand to show almost no growth in 2019, but it is expected to pick up in 2020 before the introduction of stringent pollution standards in April 2020. The Turkish auto industry

The new officers are elected for a one-year period. The Board of Directors also elected the twelve members of the 2019/20 Executive Committee (pictured) front row:

■ ChenN Derong, Chairman of the Board,

## While the global economic outlook is highly unpredictable, we expect to see further growth in steel demand in 2020 of 1.7%

*Al Remeithi, Chairman of the worldsteel Economics Committee*

continues to struggle with contraction in both domestic and export markets. In Brazil and Mexico, auto production maintained positive but slowing growth in 2019.

### Mechanical machinery

After strong growth in 2017-18, global mechanical machinery is expected to decelerate to remain flat in 2019-20 as the deceleration of the global economy and continuation of trade tensions hurt global investment activities.

The mechanical machinery output in major exporters – China, Germany and Japan – is expected to keep falling in 2020. The Chinese mechanical machinery sector is expected to decline by -1.0% in 2019, even though the replacement demand for equipment will provide some support in 2019 and 2020.

General-purpose machinery, including energy related machinery, will positively contribute to the sector's growth. On the other hand, construction machinery is expected to decline in 2019 and 2020, but the decline will be partially offset by the demand deriving from expansion of infrastructure projects in developing countries.

### worldsteel elects new officers

The Board of Directors of worldsteel elected the following new officers for 2019/2020:

- Chairman – YU Yong, Chairman, HBIS Group Co., Ltd.
- Vice Chairman – Sajjan Jindal, Chairman and Managing Director, JSW Steel Limited
- Vice Chairman – André Johannpeter, Executive Vice Chairman, Gerdau S.A.
- Treasurer – Roger Newport, Chief Executive Officer, AK Steel

China Baowu Steel Group Corporation Limited

- Koji Kakigi, President and CEO, JFE Steel Corporation
- Sajjan Jindal, Chairman and Managing Director, JSW Steel Limited
- André Johannpeter, Executive Vice Chairman, Gerdau S.A.
- Yu Yong, Chairman, HBIS Group Co., Ltd.
- Paolo Rocca, CEO, Techint Group

back row:

- Edwin Basson, Director General, World Steel Association
- Jeong-Woo Choi, CEO, POSCO
- Kosei Shindo, President, Representative Director, Nippon Steel Corporation
- Roger Newport, Chief Executive Officer, AK Steel Corporation
- John Ferriola, Chairman, Chief Executive Officer, President, Nucor Corporation
- Thachath Viswanath Narendran, Chief Executive Officer & Managing Director, Tata Steel Limited.

The Board of Directors welcomed five new regular world-

steel member companies and three national organisations as new affiliated members. The winners of the 10th Steelie Awards were announced at the Annual Dinner. The Steelie Awards recognise member companies or individuals for their contribution to the steel industry over a one-year period. The Steelies are awarded in seven categories.

*Note: The statistical issues reported by worldsteel in previous SROs relating to the closure of induction furnaces and the consequent underreporting of demand in official figures will have now largely played through the system. However, it is believed that some degree of underreporting from 2018 could still affect the 2019 growth rate. Due to this effect, while nominal growth points to 7.8% in 2019, worldsteel estimates real growth to be 4.0%.*

■ World Steel Association (worldsteel), Brussels, Belgium



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**Proactive – carbon-free – efficient**

# Dillinger and Saarstahl to realign and launch joint future-oriented programme

Dillinger and Saarstahl have jointly developed an integrated strategy for the conversion to carbon-free production targeting double-digit profitability (EBITDA margin) and cost savings amounting to EUR 250 million. Besides a comprehensive sales offensive, this will involve the reduction of 1,500 jobs and the outsourcing of 1,000 jobs in the Saar region. Saarstahl has been operating with short-time work schedules since September.

Saarland's steel industry is realigning. "We are doing this in a completely integrated process at Dillinger and Saarstahl with the long-term goal of continuing the intergenerational contract," said Tim Hartmann, Chairman of the Board of Management of Dillinger and Saarstahl. "We will be launching a comprehensive sales offensive. The commitment of our employees is high. At the same time, our costs are too high when compared with our competitors. We will be adjusting our structures and processes accordingly in the coming months. The goal is double-digit profitability that gives us sufficient scope for growth investments. In addition, we are clearly aligning the entire company in the direction of carbonfree technologies. We meanwhile expect politicians to provide a fair competitive framework and sufficient funds in the short term to implement the transfer process."

The ongoing structural crisis in the global steel market and the partial economic downturn in demand in segments such as the automotive industry and machine manufacturing, as well as the rising costs of the carbon certification system, have prompted the companies to set up an integrated strategy process to develop and implement measures to safeguard the future. The first results of the ongoing strategy process were presented to the supervisory bodies of the companies by end of September followed by information events to explain the strategy to employees.

## Proactive and carbon-free

"For the first time, teams of experts from Saarstahl, Dillinger and SHS have worked together to develop the strategic goals for the future," explained Tim Hartmann. He added: "The result of the process is clearly defined objectives and a detailed action plan

**The goal is double-digit profitability that gives us sufficient scope for growth investments. In addition, we are clearly aligning the entire company in the direction of carbonfree technologies.**

*Tim Hartmann, Chairman of the Board of Management*

for the next few years. We are convinced that this will enable us to cope with the identified challenges and to secure our future."

"A central component is a proactive realignment of the business strategy that calls for consistent management toward innovative and high-quality products for our customers. The implemented measures will help us become more robust, more profitable and more future focused. As part of the ongoing development of a carbon strategy, options are being formulated for the gradual conversion to carbon-free production. We call on political leaders here to very quickly enable a clear planning capability and create the conditions for fair competition as well as for the necessary financial assistance."

## Cost savings and socially responsible job cuts

Dillinger and Saarstahl set a goal of cutting costs by EUR 250 million per year. They will achieve 60% of this through savings in the cost of materials and external services and 40% in personnel expenses. This will involve the reduction of 1,500 jobs and the outsourcing of 1,000 jobs in Saarland.

Tim Hartmann: "We are achieving these job-related measures by changing processes and structures, increasing our productivity, eliminating duplicate structures and closing or outsourcing areas, among other things. We intend to implement the above-mentioned personnel measures in a

socially responsible manner over the next three years and are prepared to refrain from dismissing employees for operational reasons if mutual agreement is reached on the relevant instruments. Discussions with the co-determination bodies on this subject will be initiated soon."

## Background: current market environment

The steel industry in Europe is experiencing an economic crisis and – more seriously – a protracted structural crisis. The primary reasons for the increasingly challenging environment are growing worldwide protectionism and the associated tariffs, which make the products of the Saarland steel industry more expensive, large overcapacities and high imports into the EU that continuously depress price levels, and heavy competition. In the future, the increasing costs of the carbon certification system will also burden the companies Dillinger and Saarstahl. In addition to the structural problems, the current economic downturns and upheavals in core consumer segments such as the automotive industry and mechanical engineering are also affecting the economy. As a result, Saarstahl has been operating with short-time work schedules since September.

■ SHS – Stahl-Holding-Saar, Dillingen, Germany

## Ending the joint venture

# Siemens to sell its stake in the Primetals Technologies JV

Mitsubishi-Hitachi Metals Machinery is to become sole owner of Primetals Technologies. The closing of this transaction is expected by early calendar year 2020. Financial details are not disclosed.

Mitsubishi-Hitachi Metals Machinery (MHMM) – an MHI group company – and Siemens AG reached agreement on September 30, 2019, that MHMM will acquire Siemens' 49 percent stake in Primetals Technologies. Closing of the transaction is subject to customary conditions and is expected by early 2020. Siemens will support the process to ensure a successful closing of the transaction. Following closing, MHMM will assume sole control of Primetals Technologies. Financial details of the transaction were not disclosed.

Primetals Technologies was established in January 2015 and grew out of a long history of innovation in the field of metals production established by its predecessor entities, Mitsubishi-Hitachi Metals Machinery and Siemens VAI. Primetals Technologies is a worldwide leading engineering, plant-building, and lifecycle services partner for the metals industry offering a complete technology, product, and service portfolio that includes integrated electrics, automation, and environmental solutions. This covers every step of the iron and steel production chain, extending

strong leadership and deep experience in the industrial machinery business. MHI expects that Primetals Technologies will build on these foundations and strengthen its business in the future."

Jochen Eickholt, Chairman of Siemens Portfolio Companies said: "We have successfully brought together our activities in metal plant equipment and have achieved a lot together. Now the time is right for Primetals Technologies to develop even further under the full ownership of Mitsubishi-Hitachi Metals Machinery. The agreement with MHI

**As a result of Siemens' focus on productivity, production-related processes, and advanced automation, Primetals Technologies has improved across the board and been able to prepare for the challenges it will face in the coming years**

*Satoru Iijima, CEO and Chairman of the Board of Primetals Technologies*



**Satoru Iijima, CEO and Chairman of the Board of Primetals Technologies** (Picture: Primetals Technologies)

from the raw materials to the finished product – in addition to the latest rolling solutions for the nonferrous metals sector.

The creation of the JV was a result of the desire to closely collaborate in the field of metals machinery and develop an enterprise between MHI and Siemens that would be renowned for its technical and business excellence. Primetals Technologies employs around 7,000 employees worldwide.

Takashi Ishizuka, President and CEO, Industry & Infrastructure of MHI, MHMM's parent company, expressed his appreciation to Siemens: "I would like to express my deep gratitude to Siemens for their enormous contribution to Primetals Technologies over the past four years and nine months. Primetals Technologies has been able to establish a highly successful business through Siemens'

benefits customers, employees, and owners alike."

Satoru Iijima, CEO and Chairman of the Board of Primetals Technologies, also expressed his deep appreciation to Siemens and looked toward new cooperation opportunities with Siemens in the future: "We have learned a great deal from Siemens' contributions to Primetals Technologies. As a result of Siemens' focus on productivity, production-related processes, and advanced automation, Primetals Technologies has improved across the board and been able to prepare for the challenges it will face in the coming years."

**Siemens AG, Munich, Germany**  
**Mitsubishi Heavy Industries, Tokyo, Japan**



## World's largest thin-slab facility

# Steel Dynamics to build new flat roll steel mill for AHSS grades

Steel Dynamics, Inc. has selected Sinton, Texas/USA, as the site for the company's new flat steel complex. Steel Dynamics, Inc. has awarded SMS group the order for the supply of the complete steel production line, from the steelworks to the CSP® plant and from the cold rolling mill to the galvanizing line for this new flat roll steel mill with an annual capacity of 3 million US short tons (2.7 million t) of steel.

Steel Dynamics, Inc. announced the selection of Sinton, Texas, as the site for the company's previously announced new state-of-the-art, flat roll steel mill. Sinton is located approximately 30 miles Northwest of the port of Corpus Christi, Texas. The site is strategically located within the targeted Southwest U.S. and Mexico market regions, bringing numerous competitive customer and raw material advantages to the project. Final determination is still subject to the anticipated receipt of necessary permits and continued state and local government support, which the company expects to be forthcoming.

"We are extremely excited to announce our selection of Sinton as the site for our next-generation, new flat roll steel mill investment," said Mark D. Millett, President and Chief Executive Officer. "We are eager to join the Sinton community, and we appreciate the warm welcome and

**Our team has selected a suite of technologies based on our proven history of success, that should allow us to achieve steel grades previously out of reach to thin-slab casting technology, while sustaining the low-energy and low-carbon footprint that is at the core of our steelmaking operations**

*Mark D. Millett, President and CEO, Steel Dynamics, Inc.*

support that we have received from them, Governor Abbott and the State of Texas, as well as local leaders from San Patricio County, the City of Sinton, and the Sinton Independent School Board. We thank them for their trust, shared vision, and support for this important strategic investment. We anticipate the project will create approximately 600 well-paying positions, and abundant opportunities for indirect job

growth from customers and other support service providers, bringing meaningful economic growth to the surrounding communities."

"We have been developing a flat roll steel business strategy for this region and Mexico for several years," said Millett, "and, the team is ready to execute. We have extensive experience and a proven track record for successfully constructing



**Design scheme of the new SDI Sinton flat roll steel complex: 1 – meltshop, 2 – CSP® plant, 3 – PL/TCM, 4 – skin-pass mill, 5 – galvanizing line** (Picture: SMS group)

and operating EAF steel mills and downstream value-add finishing lines. Our planned new EAF flat roll steel mill will be the most technologically advanced facility existing today. Our team has selected a suite of technologies based on our proven history of success, that should allow us to achieve steel grades previously out of reach to thin-slab casting technology, while sustaining the low-energy and low-carbon footprint that is at the core of our steelmaking operations. Based on casting capability of up to 84 inches (2,134 mm) wide and up to a 5.5-inch (140 mm) cast thickness, it will be the world's largest thin-slab facility. The steel mill will also have a unique rolling mill configuration, providing the capability to produce Advanced High Strength Steel grades, including some energy sector products not available in the U.S. today. The mill will also have the capability to produce up to 52.5 ton coils, creating meaningful cost efficiencies for certain energy customers. These advances will further reduce the gap between existing EAF and integrated steel mill production capabilities. We have already placed orders for a majority of the equipment and filed for the required permitting.

"Our customers are eager for us to begin, as we have been discussing plans for several of them to co-locate onsite with us," continued Millett. "We believe a majority of the customer base will experience a significant freight savings compared to their current supply-chain configurations. We are also making meaningful headway regarding regional prime ferrous scrap sourcing. We continue to grow increasingly excited about the expansive opportunities and long-term value creation our Southwest U.S. and Mexico growth strategy provides us," concluded Millett.

The Sinton location brings numerous advantages, including:

- proximity to the three targeted customer regions of the four-state Texas area, the Western U.S. and Mexico representing approximately 27 million short tons of relevant flat roll steel consumption,
- customer-centric logistic benefits, providing shorter lead times and meaningful customer working capital savings,
- central to the largest domestic consumption of flat roll Galvalume® and construction painted products, with the anticipated ability to effectively compete with excessive regional imports,

## SMS group to supply a complete steel production line

Steel Dynamics Inc. has awarded SMS group an order for the supply of a complete 3 million t/year steel production line, from the steelworks to the CSP® plant and from the cold rolling mill to the galvanizing line for its Sinton, TX location. In addition to the mechanical equipment from the liquid phase up to strip processing, the scope of supply by SMS group comprises X-Pact® electrical and automation systems as well as technical support during installation and commissioning.

The steelworks will be equipped with two DC-EAFs having a capacity of 210 short tons (190 tons) each and two twin ladle furnaces (LF) and a double vacuum tank degasser (VD).

The CSP® continuous caster is designed for a yield of 7.5 tons per minute and casting speeds of up to 19.7 ft/min (6 m/min) are attained. An eight-stand hot rolling mill will enable SDI to produce API hot strip grades with thicknesses up to 1" (25.4 mm). The hot strip mill is designed for a minimal strip thickness of 0.047" (1.2 mm).

Following the CSP® plant, a pickling line/tandem cold mill (PL/TCM) will be arranged. The new steel mill will also have a continuous galvanizing line. For post-treatment, the line will be equipped with a four-high skin-pass mill stand.

The applied concept and equipment provide a solid foundation for the digitalization of the plants and processes and for future-oriented extensions and applications. Diagnosis and visualization concepts will be used in the entire plant.

■ SMS group, Düsseldorf, Germany

- sufficient acreage to allow customers to locate on-site, providing logistic savings and steel mill volume base-loading opportunities,
- proximity to prime ferrous scrap generation via the four-state Texas region and Mexico, and cost-effective access to pig iron through the deep-water port of Corpus Christi, as well as other alternative iron units,
- excellent logistics provided by on-site access to two class I railroads, trans-loading opportunities with a third class I railroad, proximity to a major U.S. highway system, and access to the deep-water port of Corpus Christi, and
- existing, mature and dependable power, natural gas, and water sources.

This investment will benefit from Steel Dynamics' focus on safety, its low-cost, highly variable operating framework and entrepreneurial performance-based incentive culture. The planned facility is anticipated to have an annual production capacity of approximately 3.0 million US

short tons with the capability to produce the latest generation of Advanced High Strength Steel grades (AHSS). The project will include value-added finishing lines, including a galvanizing line with an annual capacity of 550,000 short tons (500,000 t), and a paint line with an annual coating capacity of 250,000 short tons. The product offering is anticipated to include various flat roll steel products, including hot roll, cold roll, galvanized, Galvalume® and painted steel, primarily serving the energy, automotive, construction, and appliance sectors. The current estimated required investment is approximately US\$ 1.9 billion, which does not include the benefit of anticipated state and local incentives. Upon the receipt of required environmental and operating permits, the company expects to begin construction early 2020, followed by the commencement of operations mid-2021.

■ Steel Dynamics, Inc., Fort Wayne, IN/USA



## Substitution of steel imports in the United States

# Highly flexible and profitable strip production at Big River Steel, USA

The steel production complex of Big River Steel (BRS) comprises the latest CSP® plant started up in the USA. The overall layout enables short distances between the facilities as well as simple coil handling. In the final stage, the plant is designed for a production capacity of up to 3.0 million tons per year. At its maximum strip width of 1,930 mm, the CSP® plant is the widest thin slab casting and rolling plant worldwide. The process technology is being adopted to produce ultra-low carbon steels for automotive grades, electrical steels and near segregation-free sour service grade line pipe steels.

Going along with foundation of Big River Steel LLC (BRS) in 2014, it was decided to build a new plant for the flexible production of high-quality hot-rolled and cold-rolled steel. At the BRS site in Osceola, Arkansas/USA – on the banks of the Mississippi River – thus, the new steel complex covered the entire process chain from steel production to hot-dip galvanizing. The ground-breaking ceremony at the end of September 2014 marked the start of the project. The entire process equipment, including the electrical and automation engineering as well as the environmental systems, was supplied by

SMS group. The complex was started up on 11 December 2016 with the first melt, the first casting and the first coil.

BRS's plant technology is completely focused on flexible production of demanding steel grades, such as OCTG steel grades, line pipe grades according API standard including sour gas resistance, silicon steels for electrical application like in electric mobility, AHSS grades as light-weight steels for the automotive industry and other high-strength and wear-resistant steels grades for use as structural steel or in agricultural and earthmoving machines.

## Approach

The flat rolled steel complex at Big River Steel (BRS) is the latest in technological exploitation in CSP® technology. Its approach is to focus on highly flexible production of value-added steel grades. This together with the objective to reduce the operational cost by exploiting all technical and technological possibilities along the entire process chain including digitalization is the basis of BRS's competitiveness.

Consequently, BRS identified profitable market segments such as HSLA, API line pipe, OCTG grades for the energy sector, extra deep drawing steels (EDDS) and AHSS steels for the automotive sectors. Further CRML (cold rolled motor lamination) and NGO SP (non-grain oriented semi-processed) electrical grades are part of its product mix. In the future, BRS also intends to prepare itself for the production of CGO (conventional grain oriented silicon steel) and H-GO (high permeability grain oriented silicon steel).

The approach, BRS chose to establish itself in the market and to serve this wide spectrum of niche products, distinguished three major phases. The first phase was to produce 1.5 million tons of high quality hot and cold rolled as well as processed steel strips. In the second phase, BRS will double its production capacity by extending the steel making plant and the CSP® plant. In the last phase it will further extend its capability to widen its product spectrum.

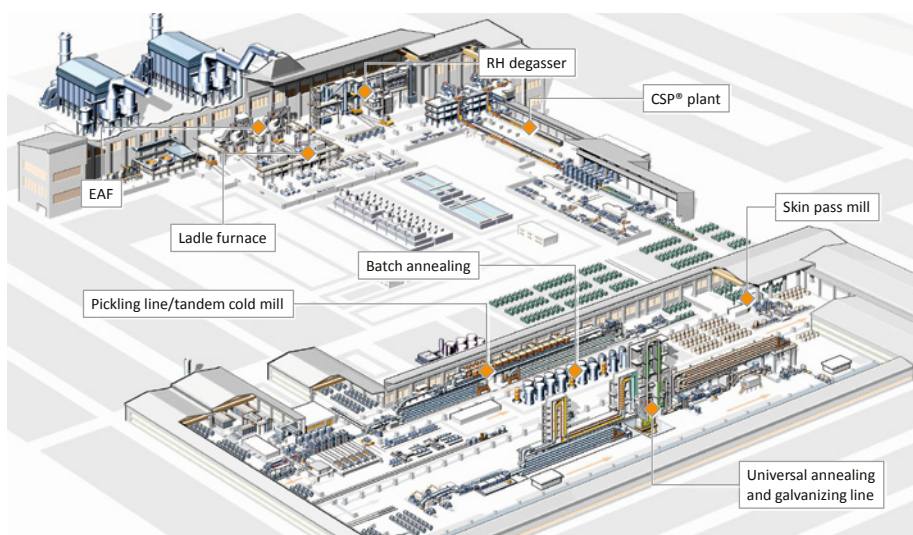


Figure 1. Layout of the flat rolled steel complex at Big River Steel (Picture: SMS group)

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## Plant overview

In the first phase BRS installed the steel-making plant, a one strand CSP® plant with a capacity of 1.5 million t/ year, one pickling line/tandem cold mill (PL/TCM), a continuous annealing and hot dip galvanizing line, batch annealing furnaces and an offline skin pass mill (**figure 1**).

The overall layout is based on a “U” shape and enables short distances between the facilities as well as simple coil handling. In order to ensure flexible response to market demands, the plant is built in a way that BRS can obtain products for sale after various stages of the overall process (**figure 2**).

The steel making plant consists of a direct current electrical arc furnace with a tapping weight of 150 t. Charge material includes commercial scrap grades and – depending on the steel grade produced, pig iron, DRI or HBI. For metallurgical refining and alloying a ladle furnace is used designed as twin station with joint electrodes to reduce idle time due to ladle handling. Also for vacuum treatment a Ruhrstahl-Heraeus (RH) degasser is installed with TOP lance for forced decarburization and chemical heating. The RH degasser has a capacity of 145 t per ladle. The process is characterized by short treatment time and flexible ladle handling. This gives BRS the opportunity of economical mass production of high-quality steel grades with ultra-low carbon and low gas content. The combination of EAF and RH degasser is the first one in North America.

The CSP® plant is designed to produce strips with a width of up to 1,930 mm (76”) and a final thickness between 1.4 mm and 25.4 mm. The CSP® Caster is a vertical solid bending (VSB) type. Slab thickness is 85 mm which can be flexibly reduced down to 55 mm by liquid core reduction (LCR). The caster is equipped with mold temperature mapping (MTM), X-Pact® solid process model, breakout detection and electromagnetic brake (EMBR) for reduced turbulence thereby improving steel internal as well as surface quality.

The CSP® furnace was designed to minimize energy consumption and to nevertheless achieve ideal heating-through of the thin slabs. The entire roller hearth furnace is equipped with environmentally compatible ultra-low NO<sub>x</sub> burners. At a measured average NO<sub>x</sub> emission of 85 mg/Nm<sup>3</sup>. The furnace of Big River Steel

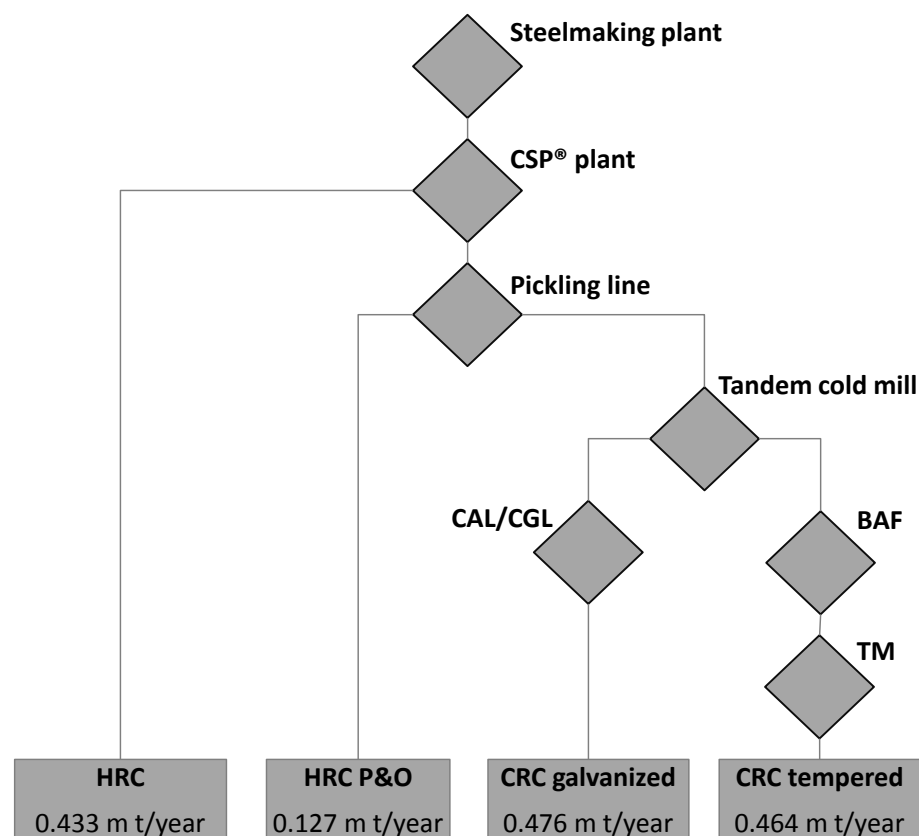


Figure 2. Phase 1 configuration and material flow at Big River Steel (Picture: SMS group)

sets a standard with regard to environmental compatibility. This emission level is far below the statutory limit value.

Slab transport through the furnace is carried out by water-cooled rollers with a special insulation. These rollers reduce the energy loss by more than 30% in comparison with conventional rollers. This significant increase in energy efficiency reduces the gas consumption and hence allows saving of operating costs. The overall reduction of energy consumption in the furnace is more than 20%. Energy consumption of the furnace when fed with slabs with a cross-section of 65 mm x 1800 mm and a casting speed of 5.0 m/

minute is as low as 35.2 kWh/t over 100 m of furnace length (**table 1**). The control of the furnace uses the powerful X-Pact® Dynamic Furnace Control Model (DFC). This model ensures the heating of the slab to the desired temperature at a high degree of uniformity over length, width and thickness.

The 6-stand CSP® rolling mill is fitted with all technologies and components for the cost-effective production of high-quality hot strip with excellent product tolerances. These include the advanced guiding system to improve strip stirring, the latest descaling technology, hydraulic gauge adjustment, CVC plus® technology,

Table 1. Specific energy consumption for different slab dimensions

Slab dimensions and casting speeds	Mass flow in t/h	Specific energy consumption in kWh/(t m)
65 mm x 1,600 mm 4.0 m/min	189	0.542
65 mm x 1,800 mm 4.5 m/min	240	0.421
65 mm x 1,800 mm 5.0 m/min	267	0.352



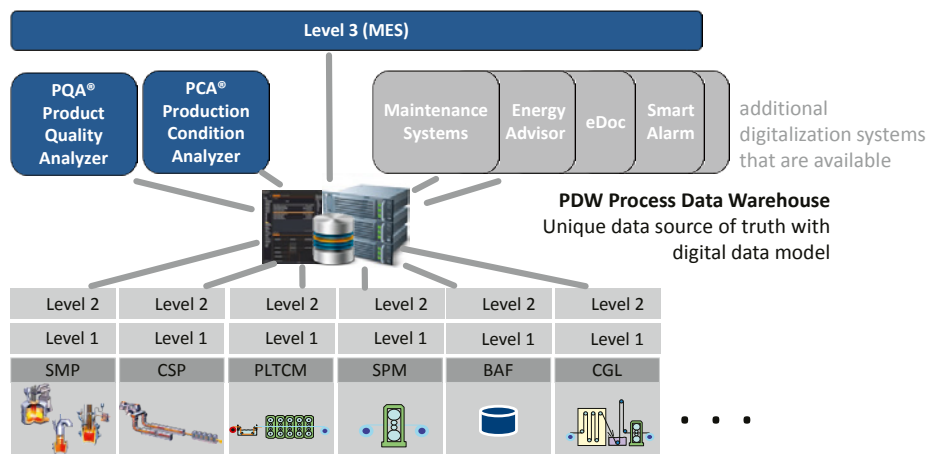


Figure 3. Overall structure to implement the Learning Factory approach (Picture: SMS group)

as well as an advanced Level 2 system with material property model to ensure product quality and to reduce the development time for new products.

The laminar cooling is equipped with 12 groups as following:

- 3 groups are designed as super reinforced zones,
- 8 as micro zones and
- 1 as trimming zone.

All groups are equipped with latest version of the edge masking, able to follow the strip edge. It improves the mechanical properties near the strip edge, the temperature profile across the width and thus the flatness of the hot rolled strip in cold condition.

The pickling line / tandem cold mill (PL/TCM) is designed to process up to 900,000 tons of steel strip per year with strip widths ranging from 914 to 1,880 mm and an entry thickness in the range of 1.4 to 5.0 mm. It is equipped with an X-Pro® laser welder, a scale breaker, a turbulence pickling section and a five stand tandem cold mill. The latter reduces the steel strip to final gauges of 0.27 to 1.4 mm. To produce pickled and oiled strip the pickling line is equipped in the exit of the pickling section with the DUMA-BANDZINK oiling machine.

The four-high mill stands of the tandem cold mill (TCM) are fitted with CVC plus® technology featuring positive and negative work-roll bending. Together with the multi-zone cooling system and X-Shape flatness measuring roll, it ensures optimal strip flatness. Further the TCM is equipped with the latest fume exhaust system reducing fume generation by optimized air flow conditions, able to meet the extreme-

ly strict U.S. requirements on exhaust-air particle emissions.

The continuous annealing and hot dip galvanizing line gives great flexibility in strip processing enabling the production of coated and uncoated strips for a wide range of steel grades. This is done highly energy efficient and environmental friendly due to the intelligent I-furnace technology integrating process models and innovative online measurement technologies.

In addition, BRS uses 25 batch annealing furnaces with innovative process intelligent ensuring excellent cold strip treatment and throughput optimized operation with an annual capacity of 413,000 t. The subsequent offline skin-pass mill with a rolling force of 18,000 kN enable skin passing of super hard complex phase automotive grades and is capable of providing up to 13% elongation for motor lamination grades.

All the described process facilities including the electrical equipment and the automation systems were supplied by SMS group. From planning to detail engineering for every process stage, BRS and SMS attached great importance to minimizing of energy consumption and using innovative technologies to reduce emissions. In March 2017, BRS became the first LEED (Leadership in Energy and Environmental Design) certified steel production facility in the US.

### Learning factory

A modern steelworks with highly flexible process chain and latest technologies to ensure high quality steel products, as installed by BRS in Osceola, consists of

many different highly specialist systems generating an enormous amount of data. These data stored in different databases contain information about almost everything that happens in the mill. When this data is integrated, it can give answers to the equipment status, the process accuracy, how that determines the product quality or what are the operational cost drivers for particular products just to mention some information contained in the data. Therefore, this data is of high interest for various types of performance evaluation and system adaptations.

BRS and SMS consider this in the strategic approach of a Learning Factory emphasizing a high level of data integration for evaluations that are important for the operating company and its customers. Along with the SMS vision of an intelligent autonomous steel production plant, BRS and SMS established for the Learning Factory approach the overall structure as shown in **figure 3**.

The high data integration is ensured by the process data warehouse (PDW) also called as BRS database. It collects all data along the process chain able to handle batch data and streaming data. Today these are batch data related to a coil which is the smallest unit of a product in the steelworks. This includes data sets like pass schedules but also time series sampled with different sampling times in the range of milliseconds to seconds. In the future streaming data will be handled as well – which enables during the production time of a particular strip to evaluate the product quality and to react on it immediately.

For safety and security reasons the PDW separates the automation system with its Level 1 and 2 applications from the evaluation approaches. This avoids disturbing or corrupting of the running automation system by accident.

Furthermore, the data storage capacity of the various automation applications as well as of the Manufacturing Execution System (MES) can be significantly reduced. Long-term storage takes place in the PDW so that product data can be accessed over several years. BRS is able to evaluate via the PDW product data since April 2017, the date when the PDW was started up.

The X-Pact® MES 4.0 is installed as Level 3 system. It takes the sales planning data from an ERP system (SAP) and gen-

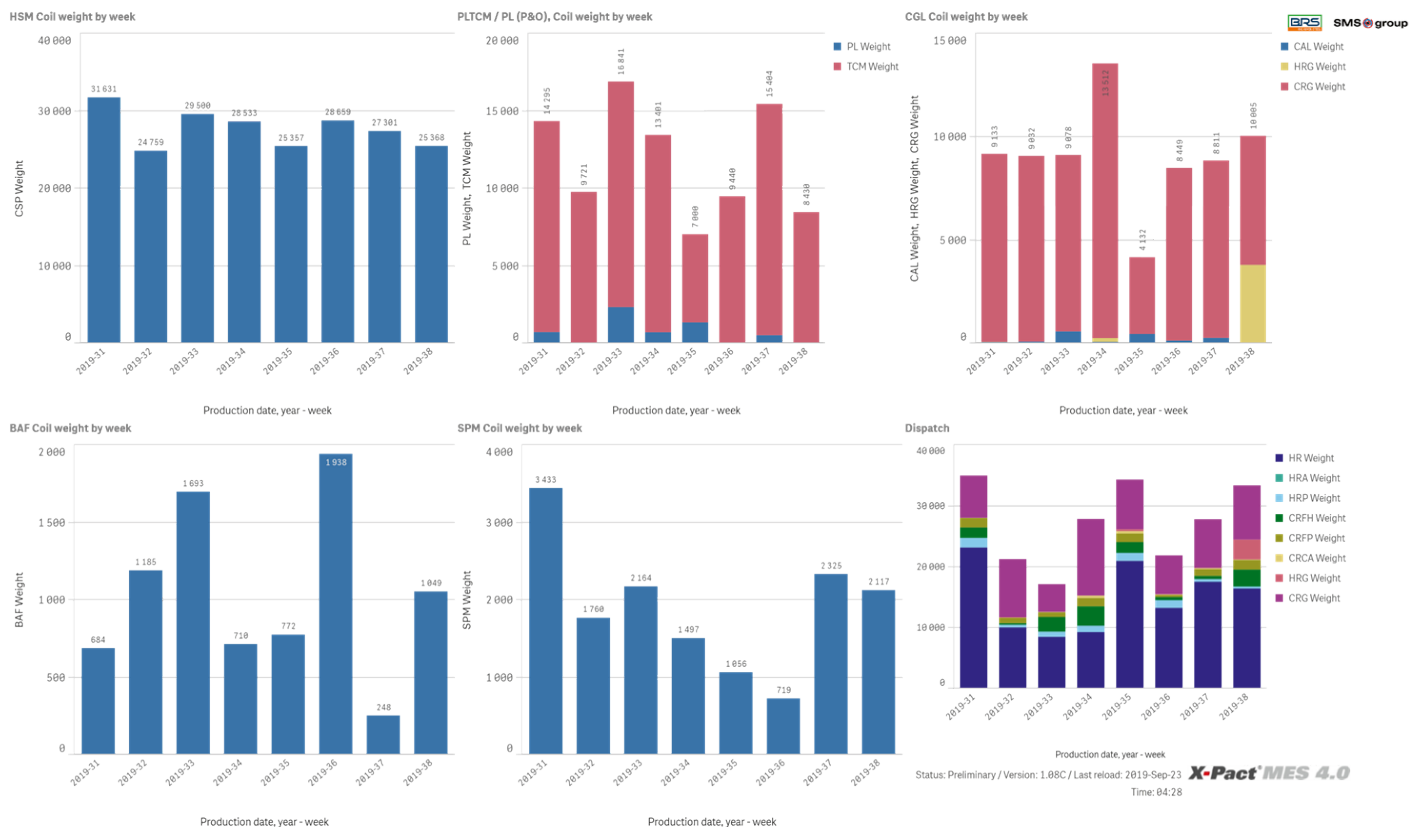


Figure 4. Report example of X-Pact® Business Intelligence (Picture: SMS group)

erates the technical production order, taking into account the process route that the material and later each coil of the order will follow, and adds specific technical parameters that are relevant for the process steps to be performed. These technical orders are used for capacity planning, considering plant availability and agreed delivery dates, while at the same time optimizing the production process with regard to set-up time, product quality and energy consumption.

Once production has started, it may be necessary to react immediately to unforeseen problems. Upon request of the plant operator the system can do a short term rescheduling, coming up with planning alternative keeping production yield high and saving plant resources.

Reporting of the Level 3, considering the order execution, is done via the MES module X-Pact® Business Intelligence (figure 4). It serves to summarize, evaluate and present the technical, economic and ecological operating data of the production plants and helps to identify improvement potentials.

Systems to support the production level are the Product Quality Analyzer (PQA®)

and the Production Condition Analyzer (PCA®). The systems qualify operators and engineers to easily identify process shortcomings and consequently it enables them to more effective and faster decision making. Benefits of these systems are a more effective workforce, reduced rejection rate and higher availability of the facilities.

The Product Quality Analyzer (PQA®) is an advanced quality management solution (figure 5). It analyzes all product characterizing data and quality relevant process information based on rules and decides whether the intermediate or final product is fit for further processing or can be shipped as prime material to the end customer. This is

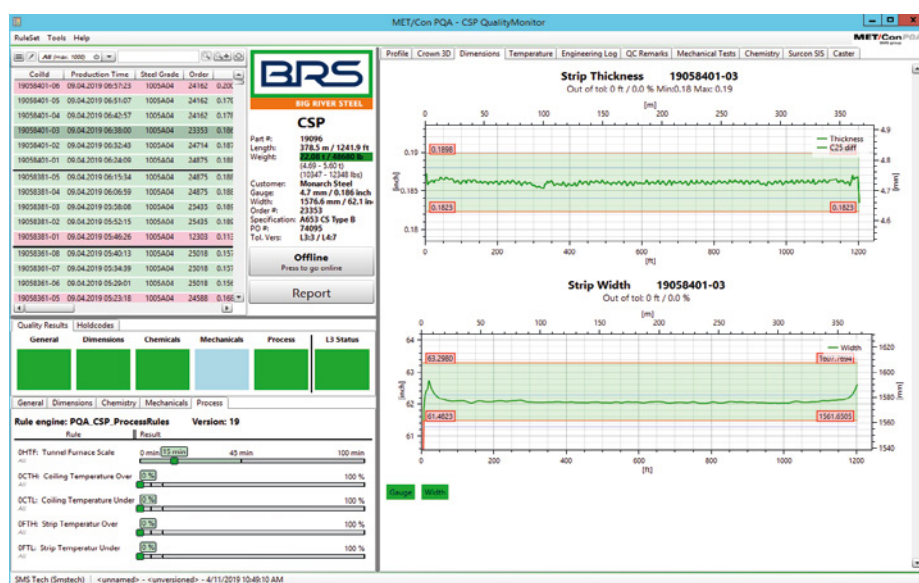


Figure 5. User interface of the Product Quality Analyzer (Picture: SMS group)



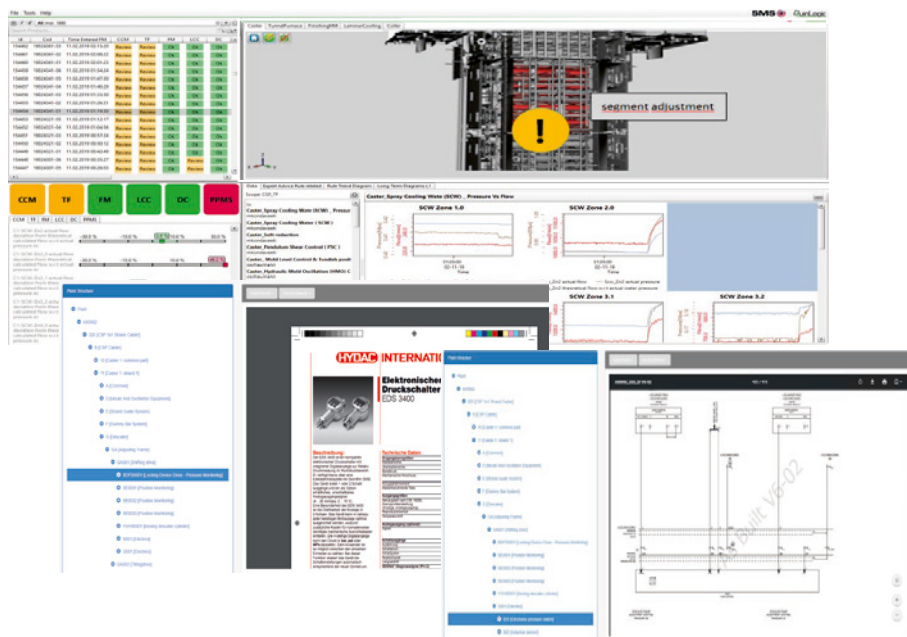


Figure 6. User interface of the Product Condition Analyzer (Picture: SMS group)

regardless of whether the final coil release is fully automatic or manual.

In case the product does not fulfil all criteria, the quality inspector can get a quick and comprehensive overview about all product and process related quality information along the production chain, from the melt shop to the process step where the product failed to fulfil the quality criteria. Based on this information, the inspector can decide how to process the product further or can trigger the X-Pact® MES 4.0 to allocate such product to a different order.

The Production Condition Analyzer (PCA®) focused on the process equipment (figure 6). It evaluates all kinds of data such as data from surface inspection systems, technological measuring systems, basic automation, process models and from the Level 3 system with regards to production and plant conditions along the

entire process chain. It visualizes where production conditions are not within the limits and where in the plant the related equipment is located.

Via a web-app this information is available to shift staff on their portable devices together with the complete documentation, starting with data sheets for sensors and functional descriptions through circuit and hydraulic diagrams to expert recommendations and mechanical drawings. Therefore the SMS information model and the eDoc System are connected to the PCA® or can be used separately. This empowers the shift staff to react faster and more effectively on occurring shortcomings and to take over more responsibilities.

Recognition of changes in the long term behavior can trigger maintenance actions in the regular maintenance shifts. There-

fore the PCA® will be linked to the used integrated maintenance management system (IMMS). This will shift the maintenance approach from a more cyclic to a more predictive one and therefore to more cost efficient operation.

Beyond the above mentioned approach BRS like to support planning, operation and process outcomes regarding quality and quantity by AI methods like machine learning and big data analysis. Therefore BRS cooperates with AI companies out of the portfolio of its equity holders. SMS partly participates in these cooperations, partly SMS works together with other partners and partly SMS is building up its own AI capabilities.

First projects realized are focused on energy consumption management optimization, delivery date prediction and on assistance systems to avoid casting defects. On the latter also SMS is focused. Further, in a next step, SMS aims to correlate product quality and production condition to distinguish on one hand between production conditions more or less relevant for product quality and on the other hand to advice - depending on the production and plant condition - what are more favorable products in terms of quality to manufacture under these conditions.

## Operational results

The CSP® plant produced its first strip on 11 December 2016. In January 2017, in the first full month of production, a total of 58,000 metric tons (63,000 US short tons) left the plant – this quantity was the world record for all CSP® plants. In early November 2017, Big River Steel surpassed the mark of one million tons produced on the CSP® plant with one strand. Two years after the first coil BRS has already pro-

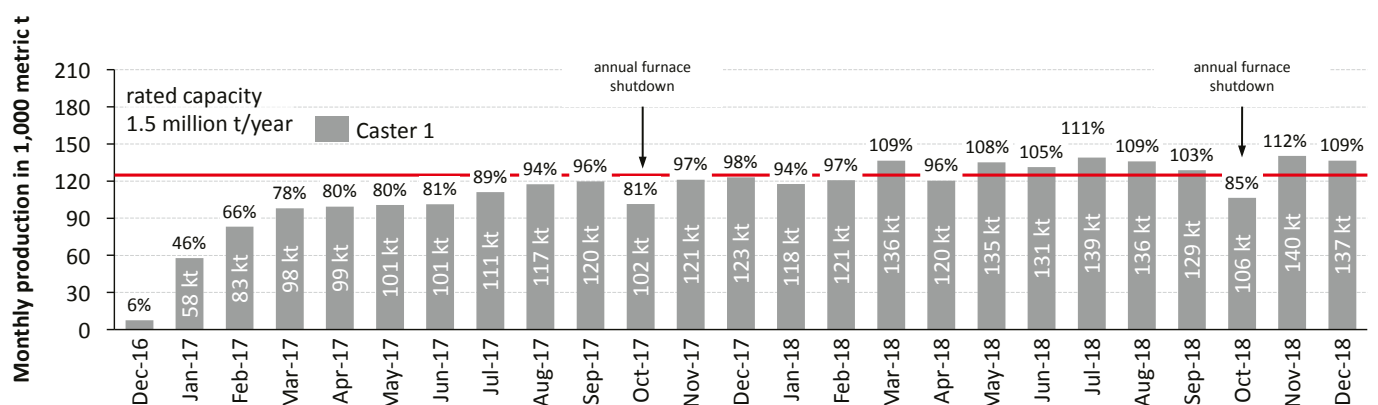


Figure 7. Output of Big River Steel from the first coil to the end of 2018 (Picture: SMS group)

duced 2.67 million tons and exceeded the rated capacity of 1.5 million tons per year during 2018 (**figure 7**).

Many customers expect from Big River Steel as a newcomer in the market very high flexibility with regard to product quality, product dimensions, lot sizes and delivery time. On account of the best plant dimensioning in every process step and the digitalization of the whole plant, all these expectations can be met at a mean lot size of only 7 coils. Almost 50 percent of the strips produced have a width of more than 1500 mm.

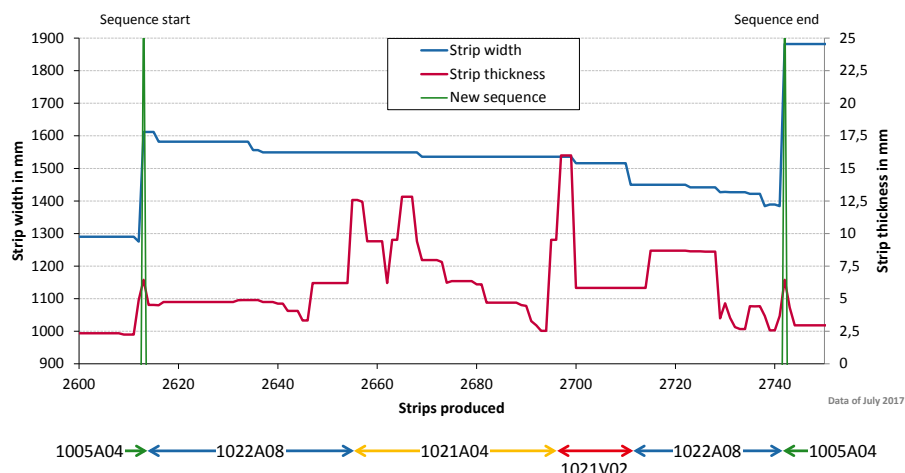
The CSP® plant is of decisive importance for the flexibility of Big River Steel. Within one sequence, considerable changes of the strip width can be effected. Strip thickness variations of more than 10 mm are realized from strip to strip (**figure 8**).

Moreover, in the case depicted here, four different steel grades are cast within the sequence. This flexibility is a decisive factor of success for Big River Steel. On one hand it is a benefit yielded by the CSP® technology due to temperature homogeneity and CVC plus® technology and on the other hand it is economically feasible due to advanced functionality to reduce the length and the number of transition slab or strips like the flexible analysis approach implemented in the Level 3 system X-Pact® MES 4.0. It reduces the number of transfer slab by more than 50 percent and saves BRS millions of dollars already during the first two years.

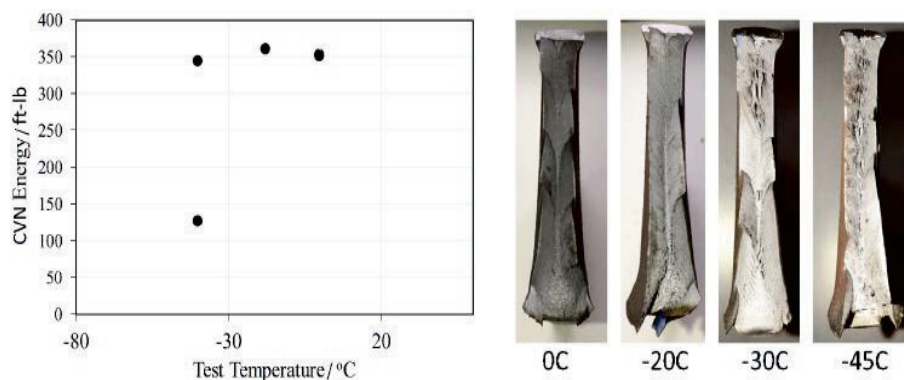
Within an implementation period of 8 weeks, the PQA® system was able to do its job and is now fully utilized in the day to day dispatching. The fundamental benefit of the PQA® system is that only products without defects leave the plant, which is very important for the development of a long-standing customer-supplier relationship.

## Product development

Just few months after the first coil attempts were made to gradually develop OCTG grades, API line pipe grades from X52 to X80, AHSS HSLA steels and extra deep drawing grades for automotive sectors. The RH degasser was commissioned in July 2017. With the first heat run through RH degasser on July 28, 2017 development started for API line pipe grades sour and non-sour applications, electrical steels and extra deep drawing (EDD) grades.



**Figure 8. Hot strip production with highest flexibility- example sequence of BRS**  
(Picture: SMS group)



**Figure 9. Charpy impact transition curves and fractured surfaces of DWTT samples of X70 coils** (Picture: SMS group)

The trials of X52 and J55 for tubular applications were conducted at the request of key ERW/HFW pipe manufacturers and are now commercially produced successfully. The first trial for the production of API X70 grade hot rolled skelp in 12.5 mm thickness was set up in August 2017 for both sour and non-sour gas applications.

Considering the high levels of internal cleanliness witnessed at BRS and the slab dimensions, chemistry of first API X70 trial heat was designed. Two heats were made one through EAF-LMF-CC route and the other through EAF-LMF-RH-CC route and the heats were cast in to 80mm thick slabs and thermo-mechanically processed to 12.5 mm thick hot rolled coils.

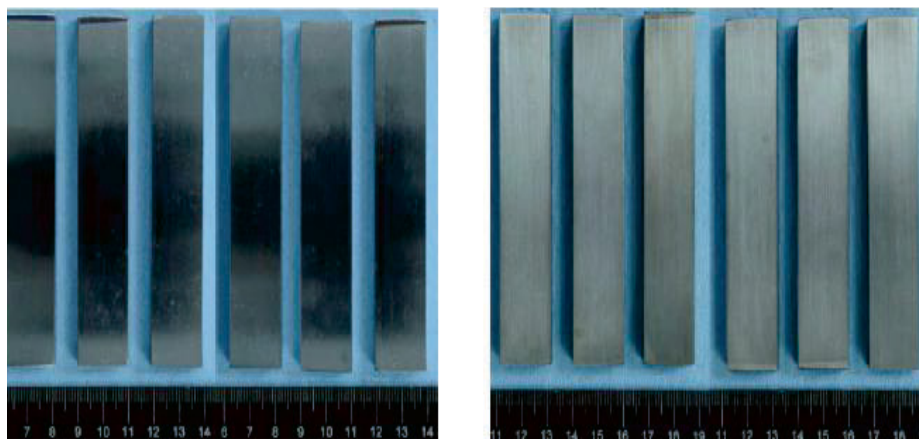
**Figure 9** shows full size transverse Charpy impact values of X70 samples. Drop weight Tear Tests (DWTT) were conducted at temperature down to -45°C and all the samples revealed excellent shear

down to that temperature. The requested mechanical properties of API X70 could be successfully obtained in the 12.5 mm thick hot rolled strips.

Samples were tested for HIC resistance as per NACE 0284-16 specification in solution A (pH 2.6) by an external specialist corrosion laboratory. The tests indicating outstanding HIC resistance of the X70 grade steel produced. **Figure 10** shows macrographs of specimens before and after HIC tests showing no hydrogen blister formation on the surfaces.

The installed steel making plant with RH enables BRS to make EDDS steels with carbon content lower than 20 ppm and excellent sulfur and gas control. BRS has started producing Ti-stabilized extra deep drawing steel since Nov 2017 with average grain size of 14 µm. Mechanical properties of fully processed 0.4 mm galvanized sheets are typically YS: 166 MPa, TS: 327 MPa,





**Figure 10. Macrographs of API X70 specimen surfaces before and after HIC tests** (Picture: SMS group)

elongation: 43%, n value(10-20): 0.228 and r: 1.59.

Regarding AHSS, the first trials for the production of the family of dual-phase steels was held in December 2017 and low carbon chemistry was adopted for the production of DP590 to avoid peritectic behavior of the steel. The steel was hot rolled to 3.3 mm and was finish processed to 1 mm thick galvanized coil.

One of the prime production targets for BRS will be electrical grades of steels considering the growth of electric cars in US market and beyond. The combination of EAF-LMF-RH-CC production sequence perfectly suits BRS for the production of

electrical grades of steels. BRS skin pass mill is capable of delivering a temper pass reduction of up to 10% and the Hi-Flo Batch annealing furnaces with 100% Hydrogen atmosphere are capable of annealing at high temperatures required of motor lamination and semi-finished NGO electrical steels.

In January 2018, Big River Steel first attempted one trial heat of 0.4Si electrical steel with less than 50 ppm carbon. The heat was processed through EAF-LMF-RH-LMF-CC. The steel was cast in to 65 mm thick slabs and hot rolled to 3.30 mm, 2.74 mm and 2.44 mm thin hot bands. Hot band coils were processed

through pickle line, cold rolled followed by batch annealing at targeted temperatures. The annealed coils were skin passed and then successful further processed at customer side. Also trials with higher Si content for motor laminations are done during 2018. Today BRS is able to deliver NGO semi processed material up to 3.2% Si content.

## Outlook

The second phase is ordered by BRS. SMS group received the contract in the beginning of 2019. The extension of the plant includes a second EAF, a second LF, a second continuous casting machine a second tunnel furnace and a second down-coiler. This additional equipment will increase the rated annual production capacity to 3.0 million tons of carbon flat rolled products. Startup of the extension will be in the end of 2020.

Further regarding the learning factory approach functionality of the installed systems should be extended. In addition AI-approaches should penetrate a wider range of product related and operational aspects to support decision making by more accurate prediction of possible outcomes. In this field BRS, SMS and other cooperation partners expect remarkable improvement in operational efficiency.

## ArcelorMittal commits to cooperation on carbon capture and storage project

**To develop value chains in carbon capture and storage, ArcelorMittal has signed a memorandum of understanding with the international energy firm Equinor.**

Equinor is a partner in the Northern Lights project, together with partners Shell and Total, which includes transport, reception and permanent storage of CO<sub>2</sub> in a reservoir in the northern part of the North Sea.

ArcelorMittal committed to the project with Equinor at a ceremony in Oslo, during a Conference on Carbon Capture and Storage (CCS) hosted by the European Com-

mission. Memorandums of understanding have been signed between Equinor and ArcelorMittal, as well as Air Liquide, Ervia, Fortum Oyj, HeidelbergCement AG, Preem, and Stockholm Exergi.

As part of the project, ArcelorMittal – which has an ambition to be carbon neutral by 2050 within Europe – has committed to a number of joint activities including the development of logistics, exploring potential commercial models, and advocating on the topic of carbon capture and use/storage, as an important part of the successful decarbonisation of the European industry. The company's primary role

will be the capture of CO<sub>2</sub> gas from its blast furnaces.

The partnership plans to drill a wildcat well for CO<sub>2</sub> storage in the Johanson formation at the end of 2019, covered by the Aurora licence (EL001) to study the reservoir's suitability and capacity for CO<sub>2</sub> storage.

Final commercial agreements will depend on positive investment decisions for the Northern Lights project, the Norwegian State's full-scale carbon capture and storage project, and for third-party projects.

**| ArcelorMittal**

## From liquid steel to rolling

# Concepts and applications for higher efficiency and zero-waste

To support the goal of sustainability, Danieli has expanded the portfolio of “green technologies.” Several energy-saving and recovery processes, zero-waste and safety concepts have been developed over recent decades.

## Sustainability principles and guidelines

In metals production “green technologies” are those that reduce emissions, waste by-products and resource consumption. Resources represent costs and so reducing the intake of raw materials and energy provides economic advantages to metals producers, but it also has benefits in terms of emissions reduction: gaseous (CO<sub>2</sub>), liquid (dirty water), and solid emissions (slag). There also are maintenance advantages, as reducing resource consumption will limit intervention and the reuse of old equipment reduces the requirement for new resources.

Personnel training and risk-analysis will limit failures or accidents, which represent costs both in terms of materials and of human beings. Also, we study start-ups and shut-downs because often these follow very un-optimized paths, in order to minimize consumption and equipment wear, to abate costs and to cut emissions and resource waste.

## Developing “green” production processes

From conceptual modeling to the prototype, the design of new equipment relies more and more on computational modeling. CFD explores new configurations, DoE reduces the number of experiments, statistical tools transform sparse data into information, and predictive models convert observations into know-how.

Environmental constraints can be implemented in these models like any other process parameters. For example, the Acou-Stack process was optimized by means of detailed CFD modelling.

Increased process efficiency directly supports decreasing energy and resources. Machine-learning tools, using databases of failures, procedures or maintenance,

have proven to be a valid aid to increasing performance in complex processes.

The most notable new examples of Danieli green technologies that have resulted in new steelmaking technologies are the Energiron process, for reduction of iron ore using hydrogen, to minimize carbon emissions; and the MI.DA. concept for Endless Casting and Rolling, with low CapEx and OpEx, to serve regional markets.

## Resources for “green” research

Model predictive control, machine learning, and IoT are some ways to transfer research teams’ experience into customer operators, with adequate training to make the most of it. More often, research projects are followed by skilled employees in cooperation with the most specialized universities, as in the development of low NO<sub>x</sub> burners, or water-oil emulsion lubricants for aluminum cold-rolling.



Figure 1. Danieli Automation dashboard for Energiron DRI plant (Picture: Danieli)

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Figure 2. The 3Q Concept pulpit installed in an ultra-modern Danieli H3 wire rod mill (Picture: Danieli)

Danieli applies its designs to present the best available techniques (BAT) and is currently introducing technologies that are well established for other industrial sectors, for economical and sustainability reasons. For example, a dry scrubbing process borrowed from the aluminum industry is effective for BF gas cleaning.

In another example, the Dan Eco system applies the most advanced technologies and automation in the field of chemical engineering for fume cleaning and recovery in aluminum rolling mills.

Higher performance means increased productivity and quality, while decreasing costs (energy, resources, failures, scraps). Using Q3-DEMS software for data recording and process monitoring, the energy efficiency can be steadily increased, according to the ISO 50001:2011 standard, in which several variables are correlated and aggregation functions are used.

### Green project goals

In projects that involve new design, layout and logistics are studied to help keep the workplace more efficient, clean and productive. In plant revamping projects there are more physical constraints, which require a customized solution that includes the most advanced and efficient solutions in the existing layouts, without modifying upstream or downstream processes.

Maintenance is focused on maximum reuse or refurbishment of old equipment, which is not only economical but also in agreement with the principles of circular

economy. Technological packages are always tailored to the actual needs of the customer, to allow full grid integration inside and outside the production site, to match with local constraints (resources, standards, regulations, etc.) Process control and monitoring are fundamental to achieve all the targets identified.

### Improving OpEx and product quality

Circular economics are revolutionizing the old and unsustainable model of 'make-use-dispose', typical of the traditional linear economy. The end-of-chain materials, instead of becoming waste, now undergo suitable treatment to enter the production cycle again, partially substituting the use of conventional raw materials. The limited resources, like water, lime or selected mineral oils, can make several passages through the process before exhausting their potential, thus reducing significantly the make-ups.

Energy consumption can be minimized with highly optimized processes, and waste gas and heat fluxes can be upgraded with the most modern technologies, like the CHR or the BOF gas utilization. Where possible, processes based on fossil fuels should be replaced by renewable electricity-based processes, like in the case of ironmaking, with the introduction of hydrogen in the DRI-EAF route, or in the reheating furnace with the new Q-Heat induction heaters.

Reducing energy demand, particularly carbon-based energy, and using renewable energy sources, also go in the direction of limiting the CO<sub>2</sub> emissions, in fulfillment of the more and more stringent international agreements on GHG emissions, with related fees.

The exemplary cases of matching sustainability, economics, and significant quality improvement are MI.DA. and QSP-DUE casting and rolling processes. With these advanced technologies, rolling processes then become stable and continuous, allowing extremely good quality products and outstanding productivity and plant efficiency.

### Technologies implemented in ironmaking and direct reduction

**CO<sub>2</sub> emissions.** BF gas has low calorific value (LHV) and can be used in low-temperature processes, even better if enriched with BOF gas, having higher LHV. Thus, BF/BOF off-gases supply power plants (25%), coking plants (15%), plate mills (20%) and to other plants and flares. One way to reduce CO<sub>2</sub> emissions is to charge an increased amount of scrap or HBI/DRI, followed by some change in operation.

Techniques for carbon capture and storage or usage (CCS or CCU) are under continuous study and some are applied already, such as recirculating the decarbonated top gas to the BF lower shaft to increase the amount of CO<sub>2</sub> in the off-gas and to ease its separation (capture).



**Robotics and automation.** Design of a modern cthouse is driven by layout and logistical optimization, dust and fumes reduction, and the use of robots in labor-intensive and repetitive tasks. Process efficiency is enhanced, by eliminating human error and implementing the best operational practices, and workplace is cleaner and safer, with lower need of maintenance.

**Maintenance represents a cost and a loss in productivity.** Minimization is desirable but only on a smart basis. While externals are constantly under inspection, condition assessment of internals requires dedicated and sophisticated simulations of wear patterns. Risk mitigation and projected remaining lifetime concepts produce an adjustment of maintenance scheduling. Failures are greatly reduced, stoppages for maintenance are delayed, and new layouts are designed to improve maintenance while reducing time and cost.

**Gas cleaning.** With reagent injection and a pressurized bag filter, BF dry scrubbing produces an effective abatement of emissions. No water consumption and improved power plant efficiency are the two indisputable advantages.

BOF gas scrubbers, including a pre-humidification step and performing the scrubbing in a variable-section, annular scrubber increases the gas-liquid contact and the abatement efficiency, while decreasing the pressure drop.

**DRI.** Ultra-low NO<sub>x</sub> burners will keep process NO<sub>x</sub> emissions below 25-30 ppm. Where limits are more stringent, a selective catalytic reactor (SCR) can bring emissions below 10 ppm. The carbon footprint of a DR-EAF plant is about 50% of that of an integrated mill; however, among the available DR technologies, the Energiron ZR has the possibility to selectively capture the CO<sub>2</sub> generated by the reduction of iron ores and this leads to a reduction in emissions by a further 60%, ready for storage or reuse, according to available CCS and CCU technologies. If hydrogen is added to the process in partial substitution of natural gas, CO<sub>2</sub> emissions can be significantly reduced.

The Energiron ZR is highly optimized, with 78% process efficiency. Further improvement in the ZR-EAF production route is possible by charging the hot DRI to the EAF. Through pneumatic transpor-



**Figure 3. Pump room of the cooling water treatment circuit at Acciaierie di Verona (Pittini Group), which serves the Danieli FastCast six-strand billet caster and the two-strand wire rod mill with a 750,000-tpy capacity (Picture: Danieli)**

tation with non-oxidizing gas, the hot DRI reaches the EAF charging bins at 600°C, thus saving energy and TTT. Furthermore, carbon content of DRI is 100% available to complete the reduction of DRI and gives some extra chemical energy to the EAF melting process.

### EAF steelmaking

ECS horizontal continuous-charging scrap preheater reduces melting energy and TTT while keeping CO, dioxins, NO<sub>x</sub> and VOC under control. Keeping the roof closed, the FTP is simpler and more efficient, and GHG emissions are reduced -7% compared to bucket charging.

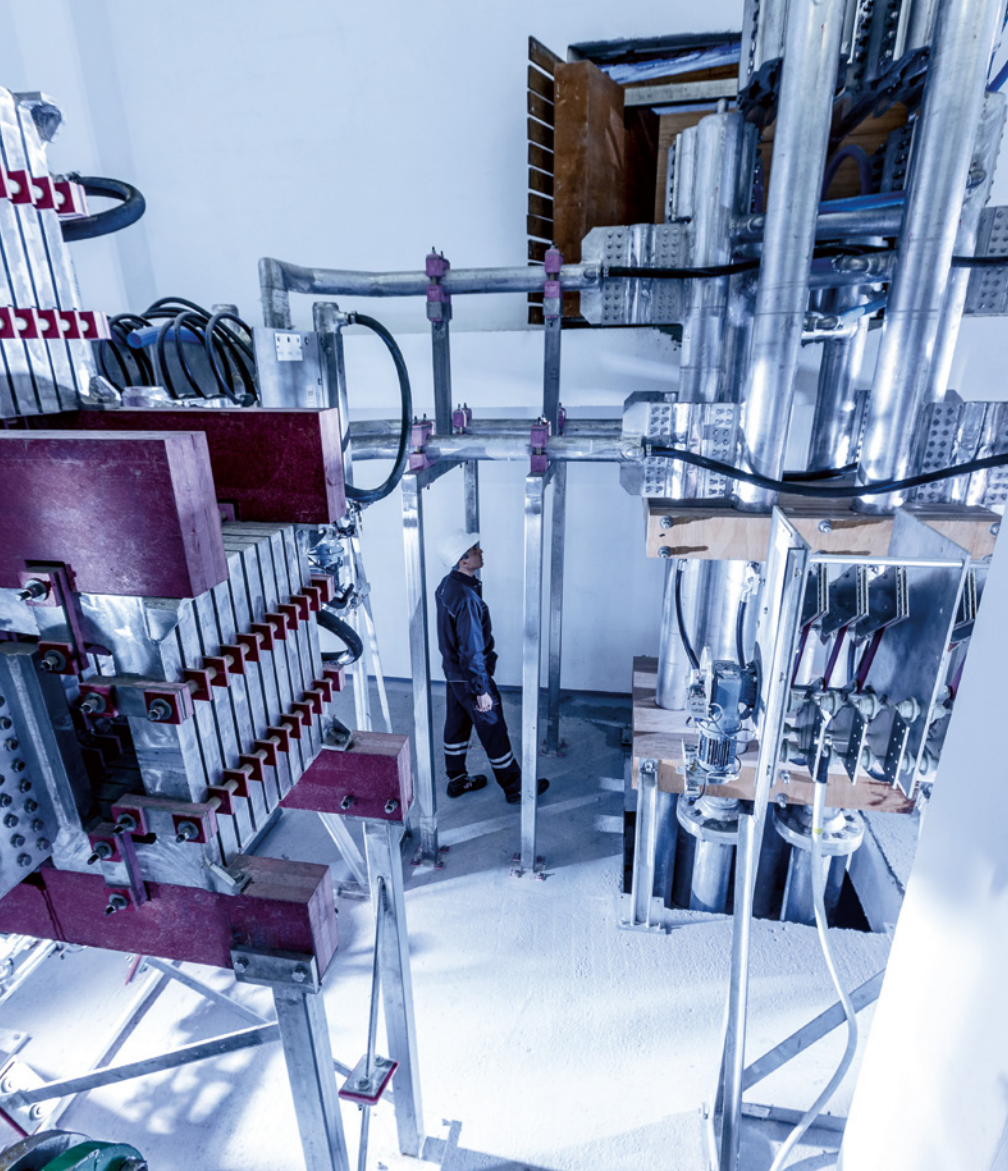
Danieli Automation tools like Q-Melt Automatic EAF adaptive process control and Q-SYM automatic scrap-yard management platform comply with the Industry 4.0 approach. Charging and melting are

controlled automatically and continuously, for consistent steel quality at minimal cost.

**Q-One** power management for conventional AC EAFs addresses problems caused by reactive power, flicker and harmonics to the network. Based on control capabilities provided by power electronic semiconductors, Q-One reduces EAF overall electric power consumption with a shorter power-on time, and lower electrode consumption. It is a modular system that can be implemented on new or existing AC EAFs, meaning that the EAF no longer requires transformers or SVC filters to perform reliably, and its modularity allows easy expansion when more power is required.

**Fume treating.** Pulse-Jet Bag Filters are the BAT to minimize the residual dust content both at the stack outlet and in working





**Figure 4. Q-ONE system – the new Danieli patented technology handles irregular power loads with flexibility and reliability** (Picture: Danieli)

areas inside the meltshop, according to customers and environmental agencies request.

Dioxins emissions reduction is also possible with the use of dedicated equipment, like the quenching tower or special dioxins abatement systems (when lower limits are required). For the control of other pollutants, like CO, NO<sub>x</sub> and SO<sub>x</sub>, it's preferable to act directly "at the source", by properly running the EAF and by choosing good quality raw materials.

**Noise reduction** can be obtained by acting directly at the main source (EAF) with the installation of a dog house or with the sound-proofing of part of the building (elephant house). To reduce the noise dispersion in the surrounding areas it is necessary to control the emissions from the stacks. The new Acou-Stack solution may replace the traditional silencer installations.

**Scrap selection.** Optimizing scrap selection reduces waste material because sep-

arating inert components (mainly glass) reduces lime additions, decreasing the volume of slag. Separating organic materials, like plastic and rubber, cuts gaseous emissions and limits the need for adsorbents to capture dioxins, thus containing the amount of dust generated. Also, scrap selection optimizes EAF operations so that melting models can manage power-on time.

### **OpEx and ecological advantages with endless casting and rolling**

Traditional hot rolling will reheat billets from room temperature, consuming around 1.2 GJ/t heat by means of fossil fuels. Up to 1% product is lost as scale, and production is not continuous. With endless casting and rolling – including MI.DA. for long products and QSP-DUE for flat products – reheating furnace is eliminated along with its energy consumption and related emissions. Furthermore, there is no scale formation during reheat-

ing and no head/tail crops, reducing waste and increasing overall plant efficiency.

### **Zero waste concepts**

**Water.** Industry must be committed to avoid wasting fresh water and so Danieli has set up a process (zero-water discharge – ZLD) wherein water treatment systems are able to recover blow-down water, with proper crystallization processes, to avoid any water discharge that may incur limits on salt content.

**Ecogravel.** Slag is a secondary raw material that provides steel scrap, 4% by weight, and is an ideal aggregate (screened for differently sized particles) to be used in road paving or concrete applications. The Danieli Ecogravel process is three times beneficial for the environment:

- It avoids the use of natural rocks, and the energy for crushing and transportation.
- It reduces landfill disposal.
- The high wearing resistance of the obtained asphalt makes roads more durable, reducing the frequency of repaving.

**ASR** (automotive shredder residue) has potential as a secondary raw material. It contains 5% inert materials, 10-15% of ferrous and nonferrous materials (which are easy to separate), and two organic fractions, equal by weight, having a calorific value up to 35MJ/kg. All evidence indicates the material may be used as a partial carbon substitute (up to 30%) for melting steel.

### **Rolling**

**Induction heaters** are a sustainable alternative to gas-fueled reheating: no GHG, NO<sub>x</sub> or particulate emissions, limited scale formation, short start-up/shut-down, and high electrical efficiency are some of the benefits. Another advantage of the QHEAT Induction Heating System is the modularity that allows easy maintenance, optimal control and material temperature equalization, resulting in increased product quality.

**Low NO<sub>x</sub> burners.** New-generation furnaces must respond to increasingly stringent emission limits. Design of high-efficiency burners requires thermo-flow-dynamics simulations with relevant combustion kinetics and final test-

ing of prototypes. Danieli Centro Combustion tested and refined ultra-low NO<sub>x</sub> burners (MAB and TFB) optimizing flame pattern, flexibility of fuel-gas feedstock, extremely low NO<sub>x</sub> emissions (particularly in the flameless configuration) and, for indirect combustion, high radiant-tube efficiency and temperature uniformity.

**Clean emulsion.** In aluminum cold rolling, water-oil emulsions may replace kerosene-based lubricants, with increased safety and lower CapEx and OpEx, related to safety equipment and to the absorption/distillation recovery system (~10%). Lower emissions also may be expected because there are no kerosene vapors to treat.

**Zero fume.** An effective design of the absorption and distillation processes can reduce VOC abatement for aluminum cold rolling. The choice of the most technologically advanced packing structures in the absorption column ensures maximum contact between vapors and the absorbent, to pick up the majority of VOCs with very low leakage through the fume plant. The distillation column that regenerates the absorption solution while recovering the rolling oil is designed with a combination of temperature and pressure that minimizes the degradation of the oil, which turns out to have a longer life. The internal recirculation in the distillation column acts as further protection for the oil, dampening the temperature peaks of the incoming solution.

**Low temperature rolling.** Improved structural steel properties have been obtained mainly by:

- restricting the carbon content;
- improving the internal cleanliness; and,
- using micro-alloyed grades combined with in-line thermomechanical processing.

This last development makes it possible to refine the microstructure to produce stronger steels and to influence the time-temperature transformation of the steel to create a microstructure more suitable for heat treatment, thus reducing treatment time and therefore costs and footprint.

## Power and automation

**Q3-OPT.** It increases plant yield, thus reducing energy demand. Upon definition of the objective functions and KPIs, the



**Figure 5. Q-ONE system with its installation was designed to ensure simple removal of the inverter and converter units, thus guaranteeing easy inspection and maintenance of the main components** (Picture: Danieli)

system quickly prompts and thoroughly reschedules the activities. The added value is the ability to manage complexity and to implement the most valuable know-how from experienced operators. An optimized plant, both in operation and in maintenance, minimizes the energy demand and the expended resources, increasing product quality and reducing wastes.

**Q3-DEMS.** It is an energy and utility monitoring and utilization tool for collecting the widest range of information and it provides a simple interface to reprocess data into KPI, predefined or used defined. Everything is recorded and monitored in order to highlight irregular operations or time-changing performances. Q3-DEMS supports continuous improvement in energy efficiency, according to ISO50001:2011.

**Smart power.** Based on inverters, assisted by an Adaptive Auto Pilot, combined with an advanced firmware and a high-efficiency induction motor, it eliminates the typical problems of a DC solution: low efficiency, high maintenance cost for the DC motor, low overload capability, network disturbances (harmonics and low power factor), etc. This technology delivers an innovative control strategy for energy savings, higher productivity, process flexibility, and reduced impact on the MV/LV distribution network.

**Data analysis.** Modern sensors and a database of failure events changed the approach to maintenance from preventive to predictive. Scheduling algorithms are generated to plan maintenance, starting from analysis of current conditions and estimating remaining performance life. Stoppages can

be reduced to a minimum and spare parts can be acquired only as needed, avoiding obsolescence and redundancy.

## Safety

**Robotics** are key where highly accurate and repetitive processes are required, as well as where there is risk to personnel safety. For example, robots are effectively used on the furnace and casting floors, as well as to tend zinc pots for galvanizing lines, for deburring, tracking, and marking rolled products, and more where other repetitive tasks are required.

“No man on the floor” is a strategic target and Q3-Pulpit technology is an example of current applications. 360° video cameras support operators with remote inspection capabilities. A database of critical events that require operators’ attention, constantly enriched through machine learning techniques, can activate some specific camera automatically to bring the event to the attention of the operator.

Today, pulpits are ergonomic and interactive, with predefined operations already available and promptly activated.

**Personnel training.** Greater skill is required to run modern plants and personnel training, together with self-learning and predictive technologies, assist operators in their choices, minimizing production issues and health hazards.

Trained workers know how to operate and maintain a plant in optimal conditions. This leads to best performances and risk reduction. Environmental benefits come from minimizing energy and resource needs, and from avoiding major failures. Danieli Training Center transfers to employees the knowledge needed to operate plants and to maintain equipment and address safety issues.



## Steelmaking

# Integrated EAF safety concept of Badische group

For safe EAF operation, the first focus has to be put on the process itself. The right set-up of the EAF is a main precondition for safe operation. Secondly, operational reliability with minimized delay rates need to be achieved. The third level of safety at the EAF can be achieved by implementing special supplementary safety equipment. Such special safety equipment concerns the temperature and sampling taking, as well as the insight shell inspection by cameras. The automation of the tapping-process, either spout- or EBT-system, are of high interest for automation to gain higher working safety levels.

**B**adische Stahlwerke GmbH (BSW) was established in 1968 by Willy Korf. Today BSW, part of the Badische group, is the biggest German supplier for the production of reinforc-

ing steel products. The core competence of Badische group is servicing the European civil construction industry by producing every steel product that goes into concrete. The group is fami-

ly-owned and divided in three lines of business: the steel production with BSW as core company, the wire processing branch for manufacturing and distribution of wire products, and – last but not least – the technology and consulting branch, which Badische Stahl-Engineering (BSE) belongs to. The companies in this branch employ and market the know-how which has been developed through countless improvement ideas and innovations from people within the group for more than 50 years of steel making.

BSW's production facilities have been designed for about 300,000 tons per year and have gone through a significant increase in annual production caused by both, investment in people and equipment. Today the plant has the permit and the investment program set up to reach 2.8 million tons of steel per year. Actually, more than 2.2 million tons were produced in the year 2015.

BSW steelmaking facilities comprehend an EAF melt shop with two 100-t EAFs equipped with 90 MVA transformers, an average tap-to-tap time of 38.9 min in Q1/2019 and an average electrical consumption of 337 kWh/t for both furnaces, having produced 449,889 tons of good billets in Q1/2019.

## Badische philosophy

Many mini mills have very similar equipment and material flow. But, what has made BSW to become one of the most efficient mini mills of the world can be described under the concept of "Badische philosophy": educated and well-trained people care for reliable equipment, and



Figure 1. MultiROB robot installed at EAF #2 of BSW (Picture: BSE)

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high productivity leading to low cost production.

- simple and reliable equipment,
- focus on consistency of efficiency,
- the "human factor",
- continuous improvement and investment in people,
- environmentally friendly production,
- optimum logistics and material flow,
- clear and integrated investment program.

Beside continuous investment in people and major investment steps in new technology, it is crucial for any steel plant to continuously find ways to increase efficiency, reliability and maintainability of existing technology and keeping an eye on the safety improvement overall. For decades, BSE and BSW have been following this strategy, having developed various innovative solutions all around the electric arc furnace in combination with the safety philosophy of the Badische group itself.

Very often melt shops intend these days to install dedicated additional safety equipment or systems with the target to improve working safety with big emphasis of state-of-the-art "machine safety" in the execution of these additional systems, but disregard the status of the main process equipment and the related process safety.

The electric arc furnace (EAF) as a main process unit for melting of "un-virgin" material, like scrap or DRI, is a very good example for the fact, that the condition and set-up of the main equipment according to production environment and pre-conditions is essential for the process safety and reliability. By ensuring a high level of process safety and reliability of the EAF, automatically a relative high level of working safety is reached, because one of the main hazards of the EAF is its product, liquid steel, in undefined conditions.

By applying this fact, the following 3 levels for overall safety of an EAF can be defined:

- right set-up and condition of the EAF main equipment and sections,
- set-up of operational standards and procedures,
- installation and use of dedicated additional safety equipment.

Steady and consequent realization of the first 2 levels leads additionally to higher process efficiency and optimized consumption figures because delay rates will be minimized.

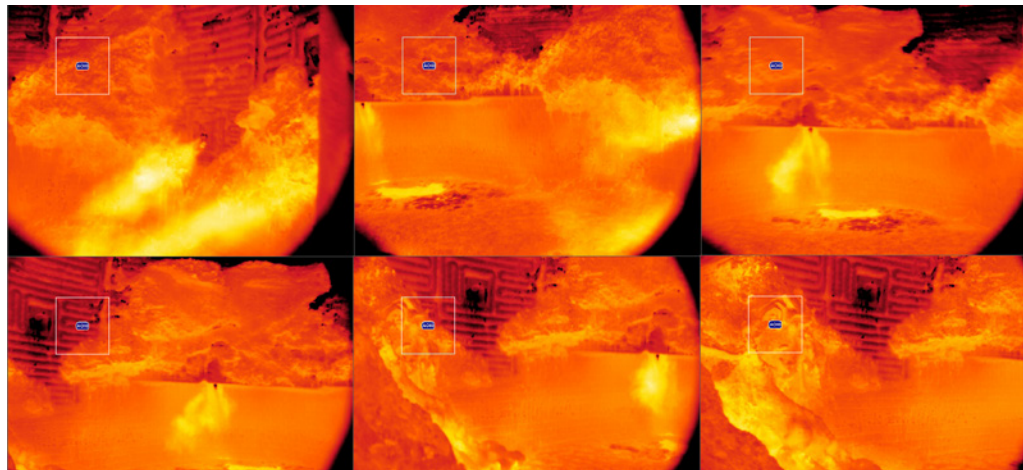


Figure 2. Thermo-scan of BSW-EAF #2 after tapping (Picture: BSE)

### Set-up of main process equipment (safety degree 1)

By analyzing the set-up of an EAF as main plant for melting of "un-virgin" metallic raw material, first of all state-of-the-art technical and safety principles and rules according to the applied physical and technical principles need to be implemented. Briefly, the following physical and technical principles and requirements need to be fulfilled:

- efficient electric power input through the arc,
- efficient chemical power input by the oxygen technology system,
- set-up of EAF shell according to tap weight and hot heel, as well as shell volume for charging,
- set-up of EAF movements for charging, de-slagging, tapping, etc.
- implementation of the EAF in the melt shop layout by respecting aspects like internal material flow, connection to power and utilities supply, connection to de-dusting system, etc.

During a modernization project 2 forty years old EAFs were substituted by one state-of-the-art 145-t EAF to fulfil production requirements of the mini mill. The modernized EAF has been installed at the place of one of the outdated EAFs in the melt shop. The existing internal buildings, such as transformer house, control and hydraulic rooms were re-used. The old foundations were substituted by completely new foundations.

One of the main important topics of the modernization was to guarantee a consecutive 2-bucket-charge with 0.6 t/m<sup>3</sup> scrap density. This requirement led to a shell set-up with an inner diameter of 7,800 mm of

the lower shell and 7,500 mm of the water-cooled panels. The overall height of the upper shell resulted in 3,400 mm. This shell layout resulted in an overall required electrode stroke of 6,000 mm.

Now the question was how to set up the EAF according to the production target within the existing melting bay and to comply with state-of-the-art safety principles and rules. The following explanation will highlight briefly the engineering solutions regarding the aspects of reliability and safety for operation and maintenance within the life-cycle of the EAF.

As a first example the required electrode stroke of 6,000 mm shall be mentioned. That big electrode stroke was realized by really rigid and stable design of the electrode lifting system. A main aspect of this is a stiff design of the gantry, as well as electrode lifting columns and electrode arms combined with self-centering column guiding units, also designed for good maintainability.

Another important safety aspect of the EAF is the implementation of fail-safe-principle in case of complete power failure. The hydraulic system design features, that the EAF can be carried into safe condition even by a complete power failure. Safe condition of the EAF means:

- EAF in horizontal position,
  - all 3 electrodes in upper position,
  - roof in upper position and swivelled out.
- Furthermore, the height of the upper shell of 3,400 mm shall be analyzed regarding safety aspects of the design. The design of the water-cooled sidewall panels can be summarized as following:
- overall height 3,400 mm,
  - 3 individual cooling circuits,



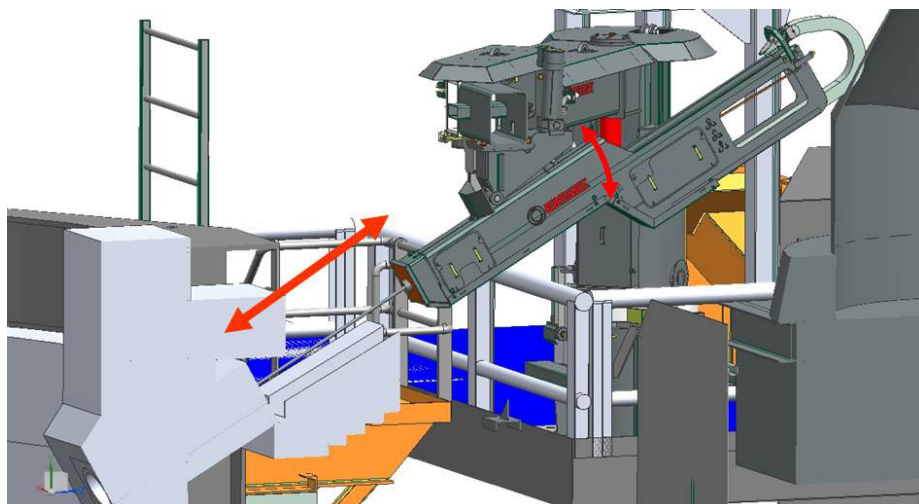


Figure 3. Spout cleaning manipulator in working position (Picture: BSE)

- 25% of cooled area (lower part) designed in copper pipes, fin-type; remaining upper area designed with steel pipes.

For overall safety, each individual water return outlet is equipped with temperature measurement with permanent recording and visualization, as well as alarm generation through the integrated automation system.

To leave it by highlighting these single examples of connection between design and safety aspects of EAF operation the following conclusion can be made.

The right design set-up of the EAF is an essential pre-condition not only for working safety. Or the other way around, the right design of an EAF with reliable engineering solutions is also a good investment in overall safety.

To have the EAF with the "right design set-up" in place and ready for production, unfortunately is only "half of the battle". To apply the operational standards can be seen as even more important. Due to the fact, that also the operational standards linked and influenced by almost numberless factors, the following chapter will be constrained by a number of typical examples and a general conclusion.

### Operational standards (safety degree 2)

To set up operational standards, certain pre-conditions have to be fulfilled, such as:

- skilled technical plant management with "management on the spot" approach,

- educated, trained and experienced workforce,
- set-up of plant organization (operation, maintenance, safety, etc.).

This aspect is of high importance to reach permanently high efficiency and productivity, as well as a high level of safety in the whole production route of a mini mill.

A first example of an operational standard for an EAF is the set-up of the charge mix. By looking on the set-up of the charge mix with scrap charge, the following main aspects have to be taken into account:

- charge composition regarding product requirements,
- availability of different scrap types,
- set-up of layout, equipment and organization for execution, as well as scrap control.

At the end, the right practical standards have to be established. One example is bucket loading practice such as different scrap layers in the bucket, with lime and carbon in the bottom and layering of heavy pieces in lower layers and for example turnings in between to be compressed with denser scrap on top. A really important aspect of operational standard in the scrap handling area regarding safety is scrap control. Hollow bodies or even explosive devices in the scrap can be only identified by applied standards of all involved operators to avoid damages and unsafe situations by preventing such things charged into the EAF.

Another example of applied operational standard at BSW is the tap hole preparation of the EAF. In the past, tap hole breakthroughs, caused by remaining slag in the tap hole channel before filled with tap hole refractory. To overcome these frequent break-

throughs with the related delays, the cleaning of the tapping channel with manual oxygen lance in combination with visual inspection before re-filling was set as a standard operation for each heat. The result was, that these events of tap hole breakthroughs nowadays do not happen anymore.

Furthermore, standard operating profiles for electrical as well as chemical power input are essential for consecutive EAF operation. As far as possible these standard profiles shall be established within the EAF automation system. Automated EAF operation with the right set-up lead also to reliable and stable operating conditions and therefore minimized delay-rates of the production route.

An integrated EAF automation system (e.g. EAF Level 1 with HMI) is furthermore the best base for the implementation of additional equipment and systems dedicated for working and process safety.

### Dedicated automation and safety equipment (safety degree 3)

For stable and consecutive EAF operation certain actions and activities must be executed to ensure productivity and quality. Due to the fact, that these actions are carried out mainly in dangerous areas, special safety equipment is required to ensure operator safety and further improve the overall process performance. The following examples show latest technological developments in the field of automation and safety equipment around the EAF.

**Robots.** The implementation and use of industrial robots in the steel processing industry opens a wider range of applications for automation of actions to avoid more and more that operators are exposed to dangerous situations. A good example for multi-function robot application is the MultiROB installation at BSW at the EAF #2 (**figure 1**). The MultiROB is installed in front of the EAF to execute the following functions:

- taking of steel sample during power-on in the EAF,
- temperature measurement of liquid steel during power-on in the EAF before tapping,
- EAF shell inspection after tapping by taking a thermo-scan via thermo-camera (**figure 2**).

The multi-functioning of the MultiROB is given by the application of a tool-changing system that enables the MultiROB to change automatically (during tapping) its

tool from temperature/sampling lance to “camera tool”. The most interesting fact is, that the inspection of the shell is executed by the MultiROB time parallel to the tap hole preparation. This means, actually without any additional power-off time. The thermo-scan cycle is programmed in the way, that the MultiROB adapts its thermo-scan-movement according to the real tilting angle of the EAF.

After the EAF inspection, the MultiROB changes its tool again automatically to be ready for sampling and temperature measurement in the course of the next heat.

**Tap hole.** As further part of EAF integrated automation for safety improvement the filling of the EBT tap hole is also already proven in daily operation of EAFs. The control of the EBT tap hole filling system is integrated in the EAF Level 1 automation and therefore the presence of an operator in the EBT area for tap hole preparation is avoided during normal EAF operation. The whole filling cycle can be observed by the operator by a dedicated camera.

To feed the filling hopper with refractory a standard pneumatic material conveying system is used. According to the lifetime of the tap hole, the amount of refractory for filling is dosed.

Next step of automation around the EBT tapping system is the automatic cleaning and clearing of the tap hole. After each tapping the EBT channel and upper rim has to be cleaned from remaining steel and slag deposits. Therefore, the device is equipped with a special oxygen radial nozzle.

In case of EBT tap hole blockage by non-metallic material (e.g. piece of concrete from scrap, electrode piece) the device clears the blockage by upwards movement through the EBT-channel.

BSE, together with BSW, developed a concept for EBT cleaning and clearing with the following pre-settings and assumptions:

- Device is equipped with oxygen radial nozzle for tap hole channel and rim cleaning.
- Max. pieces to be removed is equivalent to  $\frac{1}{4}$  m<sup>3</sup> of concrete (650 kg).
- Stroke inside shell is 600 mm, total stroke of device is 2,000 mm.
- Device can be used for tap hole changing.

To meet these pre-settings and assumptions, the “EBT cleaning and clearing



Figure 4. Spout cleaning manipulator during factory test (Picture: BSE)

device” will be mounted at the EAF tilting platform. The swivelling will be executed by electric drive, the stroke for clearing and cleaning by hydraulic cylinder. Heat exposed sections, like the lever and spike will be water-cooled for reliable operation.

Currently the planning and scheduling of the first prototype installation at BSW EAF #2 is in progress. First operational results are expected in Q1/2020.

**Spout.** Cleaning and opening of spout or syphon tapping represents also a very dangerous situation for EAF operators. Based on the “lance manipulator platform”, a manipulator was developed to clean the spout tapping system and to open it (**figure 3**). The technical features of the manipulator can be summarized as following:

- swivel of the column by electrical motor,
- moving of the hinge by hydraulic cylinder,
- stroke of arm by hydraulic cylinder,
- tilting of feeding unit by hydraulic cylinder,
- stroke of the lance by electrical motor,

■ remote control can be applied.

Depending on local conditions and requirements, a lance up to 8 m length with diameter between 3/4" to 1 1/2" can be used.

**Figure 4** shows the “cleaning and opening manipulator”, commissioned in summer 2017 at a steelmaker in North America to improve working safety in the tapping area.

## Conclusion

Nowadays many dangerous activities for EAF operation can be executed by dedicated safety equipment for sustainable improvement of working conditions as well as process safety. On the other hand, sustainability of the safety improvement can only be reached, if the dedicated safety equipment installations are embedded in an integrated safety concept considering and incorporating all 3 degrees of safety. Implementation and steady optimization of an integrated safety concept is a management task, as well as management tool for mini mills that helps to overcome contradictorily demands between operational aspects or targets and safety issues.



## Metallurgic and digitalization know-how

# Automation packages for continuous caster optimization

Primetals Technologies has installed 150 process optimization solutions for continuous casting machines in the last ten years. The advanced automation packages and cyber-physical models are in demand, especially from the USA and China. Steel producers show increasing interest in "digital twin".

One of China's largest steel producers recently awarded Primetals Technologies an order to optimize the processes of one of its continuous casters. This meant that the leading supplier of automation systems in the metallurgical industry celebrated its 150th order in the last ten years alone for process automation systems (Level 2) in continuous casting. Advanced automation packages and cyber-physical models are in especially high demand. Continuous caster operators save time and money by obtaining metallurgic and digitalization know-how from a single source. A major driver in this business is the high demand in the USA and

China. Solutions from Primetals Technologies for the automation and digitalization of continuous casters are increasingly being installed on third-party plants. Steel producers are showing growing interest in "digital twins".

### Advanced automation packages and cyber-physical models

Steel producers want to cast many grades of steel, slab thicknesses and widths on a continuous caster that produces at a high level of productivity and consistently high quality without stopping. Nowadays, advanced automation

packages and cyber-physical models ("digital twins") with a high degree of digitalization are "state-of-the-art" and form the basis for the ongoing optimization of production processes. As Dr. Peter Juza, head of the Electrical & Automation division in Linz, explained: "In keeping with these demands, we have been continually developing our solutions in recent years, and can now offer our customers the most comprehensive portfolio for the automation, digitalization and optimization of continuous casters. The number of orders in this sector more than doubled during the last fiscal year."



The digital twin for optimizing processes for continuous casters in steel works is based on many years of experience and hundreds of completed projects (Picture: Primetals Technologies)

Juza continued: "Primetals Technologies combines many years of experience in the digitalization of steel production processes with profound metallurgic know-how – which is a great advantage for our customers." One example of this is the "Model Suite", which contains the DynaPhase, Dynacs 3D and DynaGap Soft Reduction 3D solutions. This suite of modeling packages is based on state-of-the-art technology for dynamic secondary cooling and soft reduction. It takes into account thermodynamic effects, such as shrinkage and phase transitions, thus making a significant contribution toward directly improving quality during the solidification phase. Plant operators can have a digital twin of their continuous caster and the continuous casting process. This enables them to optimize production processes and the production of new grades of steel in the simulation and replay mode. This "Process Intelligent Cockpit" process can also be used for training continuous caster operators.

### Subscription licenses for process optimizing systems

The large, long-standing customer base is one of the reasons for the large number of orders for optimizing continuous caster processes. Many steel producers want to benefit from the ongoing further development of software solutions from Primetals Technologies and therefore update their systems regularly. Lively investment in the USA and China is a further factor behind the booming business. Furthermore, in the last fiscal year, the number of orders for installations in third-party plants increased substantially throughout the world.

Juza said with pride: "Our offer of a subscription license for a system for optimizing continuous casting processes is arousing great interest in the world's steel industry." With this model, new releases, upgrades and updates are installed after consultation with the customer. This keeps the customer's application up to date and allows operators to benefit from ongoing developments, improvements and inventions. The modularity of the system allows subscriptions to individual functions and models to be taken out or cancelled as required. Newly developed features and functions that become available over the course of time can also be implemented on request. The service



**The Level 2 automation solution on continuous caster CC21 in IJmuiden was commissioned 100 percent online** (Picture: Fix Media, the Netherlands)

package included in the scope of delivery offers remote support for troubleshooting, consultations, training, fine tuning and optimization. In December 2018, a US-based steel producer was the first company in the world to purchase a sub-

continuous caster CC21 in IJmuiden, the Netherlands. The correct coupling to the Level 1 system and the existing IT environment at Tata Steel Europe had previously been tested in several cold runs with on-site support of Primetals Technologies.

**We have been continually developing our solutions in recent years, and can now offer our customers the most comprehensive portfolio for the automation, digitalization and optimization of continuous casters.**

*Dr. Peter Juza, head of the Electrical & Automation division, Primetals Technologies*

scription license from Primetals Technologies for its continuous caster. Juza added: "The increasing number of customer inquiries convinces us that we have the right model for the future."

### Case example 1: successful remote commissioning at Tata Steel IJmuiden, The Netherlands

For the first time in over 50 years of cooperation, Primetals Technologies and Tata Steel Europe have commissioned a Level 2 system for a continuous caster completely online. In July 2019, Primetals Technologies and Tata Steel Europe successfully completed the entirely remote commissioning of the Level 2 system for

All 10 hot runs and commission were supported on-line, resulting in the successful casting of 140 heats with a total of 1900 slabs in mid-June 2019.

At the same time, Primetals Technologies is constructing continuous caster CC23 for Tata Steel Europe in IJmuiden, which will also be equipped with the Level 2 system. This harmonization of the automation solutions will simplify the control and optimization of the production processes. One advantage of the new solution is that the calculation algorithms and software models have additional potential to improve strand cooling, speed- and width control and thus improve production performance and right first time casting.





The new Level 1 and Level 2 systems for the billet caster of Gerdau Ouro Branco in Brazil improve the quality, reduce maintenance efforts and operating costs (Picture: Primetals Technologies)

### Case example 2: automation upgrades at Gerdau Ouro Branco

In late March, Primetals Technologies received the Final Acceptance Certifi-

cates (FACs) for automation upgrades conducted on a third-party 6-strand billet caster of Gerdau Ouro Branco in Minas Gerais, Brazil. The caster project included the upgrade of outdated Level 1 and

Level 2 systems, resulting in quality improvements, reduced maintenance requirements and operating cost savings.

The Level 2 system installed at a 6-strand billet caster encompass basic functionalities like material tracking, heat pacing, cutting schedule and process set-point generation as well as the implementation of the Equipment Expert, which is a preventive maintenance tool for the caster equipment. Advanced process models for the caster include the Dyna Speed secondary cooling model, Quality Expert Express Edition used for product quality rating, a billet cut-length optimization and the Intermix model for calculation of the heat volume concentration and incompatible strand portions along the strand.

In the course of upgrading the billet caster's Level 1 system, Primetals Technologies undertook the migration of an obsolete third-party platform to the latest state-of-the-art controllers, using a special migration kit in order to reduce risk and consequently shortening the shutdown period. Existing frequency converters were replaced by new components. A new HMI (Human Machine Interface) system, using a virtual server concept was also supplied. In addition, the existing low performance field networks were replaced by Ethernet IP, and the operation desks and panels were modernized.

■ *Primetals Technologies, Linz, Austria*

## ArcelorMittal commissions Midrex to design demonstration plant for hydrogen steel production

**ArcelorMittal has commissioned Midrex Technologies to design a demonstration plant at its Hamburg site to produce steel with hydrogen.**

Both companies have signed a framework collaboration agreement (FAC) to cooperate on several projects, ranging from research and development to the implementation of new technologies. The FAC will be governed by a number of project development agreements, incorporating the expertise of Midrex and ArcelorMittal.

The first project development agreement is to demonstrate in Hamburg the large-scale production and use of direct reduced iron (DRI) made with 100% hydrogen as the reductant.

In the coming years, the demonstration plant will produce about 100,000 t/year of direct reduced iron – initially with grey hydrogen sourced from natural gas. Conversion to green hydrogen from renewable energy sources will take place once available in sufficient quantities and at an economical cost. Energy for hydrogen produc-

tion could come from wind farms off the coast of Northern Germany.

ArcelorMittal Hamburg already produces steel using DRI technology. "With the new, hydrogen-based DRI plant we are now planning, we will raise steel production to a completely new level, as part of our Europe-wide ambition to be carbon neutral by 2050," says Dr. Uwe Braun, CEO at ArcelorMittal Hamburg.

■ *ArcelorMittal*

## Passion for precision

# Simplified sample testing in hot rolling mills

Three rolling mills of GMH Gruppe – namely Stahl Judenburg, Mannstaedt and Georgsmarienhütte GmbH – currently use the portable profile gauge CALIPRI RC220 by Nextsense. Jointly developed, the CALIPRI RC220 offers flexible contour checks along the rolling line without delay.

Four out of five cars produced in Germany incorporate steel of GMH Gruppe. Comprising of more than 20 companies in the business fields of steel production and recycling, steel processing, steering technology, forging technology and casting technology, GMH Gruppe covers the whole value chain – from scrap recycling and steelmaking down the line to manufacturing of ready-to-mount components. In order to optimize production processes and product quality three rolling mills of the GMH Gruppe – Stahl Judenburg, Mannstaedt and Georgsmarienhütte GmbH – employ the profile gauge CALIPRI RC220 by Nextsense.

## Development of a new measuring system

When Mannstaedt GmbH and Nextsense first put their heads together the vision was clear: They wanted to develop a portable profile gauge that is able to measure contours in hot condition. So far only stationary systems had this capability. But the high number of measurement points along the rolling mill would boost investment costs. Thus, a portable solution was needed.

Based on the collectively defined specific requirements Nextsense developed the first prototype. This unit was tested and further improved at the hot rolling mill of Mannstaedt GmbH. As a next step, sample devices were produced which gained attraction not only at Mannstaedt but also at the rolling plants of Stahl Judenburg and Georgsmarienhütte GmbH. That marked the birth of the CALIPRI RC220 portable profile gauge.

## Profile measurement at its finest

High expertise and a long tradition in steel are the characteristics of Stahl Judenburg, Mannstaedt and Georgsmarienhütte GmbH as well. While Mannstaedt is an

expert for hot-rolled special profiles, Stahl Judenburg has specialized in bright steel and the manufacturing of CNC machined components. The steel plant at Georgsmarienhütte GmbH is the upstream steel production facility of GMH Gruppe and produces the primary material, i.e. cast ingots, blooms, billets and bars. These primary steel products are mainly supplied to the automotive sector.

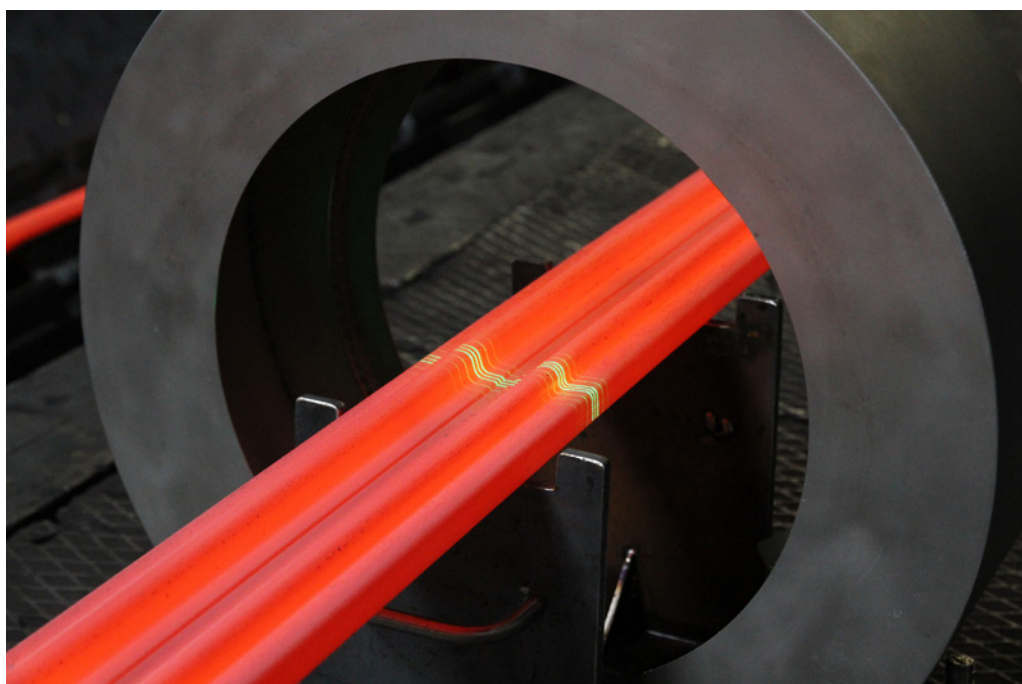
The rolling mills of GMH Gruppe have specialised their product range according to the high requirements of the customers and the market in general. In order to serve customers and markets even better the three companies leverage synergies – especially in regards to the exchange of information, joint market penetration and customer service, as well as the optimization of production processes. One of those significant optimizations included the development and use of the portable profile gauge CALIPRI RC220. The device is

used for sample testing between the rolling stands and measures long products in hot condition of up to 1,200°C.

## Meeting highest standards: steel bar and bright steel made in Judenburg

The first-class steel products of Stahl Judenburg meet highest standards since its foundation back in 1906. Recent market development caused a shift from tool steel and spring steel to automotive grades – a transition Stahl Judenburg observed and adapted to.

At Stahl Judenburg, the main focus is on the production of bright steel and CNC components. Thereby, precision plays an important role, Peter Sammt, head of production at Stahl Judenburg, explains. "For us precision stands for high standards regarding stability, uniformity and fabrication tolerances of material and geometry."



Portable profile gauge able to measure contours in hot condition (Picture: Nextsense)





The portable system CALIPRI RC220 can be used flexibly at different positions (Picture: Nextsense)

Stahl Judenburg produces 70,000 tons of bright steel and steel with special profiles per year. In order to fulfil the high standards of the market, narrow tolerances are equally important as the high-quality feedstock of bars 100% quality-proofed for both, internal and external defects.

The required precision for the production of bright steel components was further optimized by the utilization of the CALIPRI RC220 developed by Nextsense. Due to the patented CALIPRI technology the measurement of the rolled profile is performed with highest precision and within just a few seconds. The portable device is flexible in use and can be positioned at various measurement points along the bar mill. "With the CALIPRI RC220 sample testing has been considerably simplified while at the same time saving costs and increasing the transparency of processes", says Peter Sammt, manager rolling mill and heat treatment at Stahl Judenburg.

The pressing need for improvement in sample testing was the major decision factor to purchase the contactless and laser-based measurement device. "Previously, the testing was done by taking the sample directly from the production line to measure it with a caliper", explains Peter Sammt. This traditional method is quite com-

mon but old-fashioned – wasting time and money.

### **Hot rolled special profiles by Mannstaedt – developed and produced matching exact specifications**

Whenever customers need steel profiles with an extraordinary contour, they turn to the experts of Mannstaedt GmbH. For the rolling mill, precision is a matter of high-pre-

informed about market trends quite early on and can provide very individual, customized solutions quickly. Two rolling mills can transform about 200,000 tonnes of steel annually into special profiles.

One example for a special customer request is the individual profile of lift masts on forklift trucks. As soon as the customer plans a new product generation, Mannstaedt will be informed. Thus, the rolling mill can make sure the technological requirements for the production of this special profile can be met on time. Another example for special profiles produced by Mannstaedt are door hinges for the automotive industry.

Be it individual profiles of lift masts for forklift trucks or door hinges for the automotive industry, the production process for the special profiles follows a certain procedure. "We heat the material – a square profile which we buy in. In several transformation steps it is then rolled into its special shape", explains Martin Schütt, manager of one of the rolling mills at Mannstaedt. "It is here where we use the CALIPRI RC220", adds his colleague Dr. Christian Trappmann, head of the calibration department at Mannstaedt and contact person for the technical customer support. "We use the gauge to check the contour after every rolling stand along the mill. Thus, the CALIPRI RC220 is mainly used when we first produce a profile. Additionally, the profile gauge helps us to configure our existing products."

But this doesn't mean that the CALIPRI is rarely used – quite the contrary is the case. At Mannstaedt the product changes

## **With the CALIPRI RC220 sample testing has been considerably simplified while at the same time saving costs and increasing the transparency of the processes**

*Peter Sammt, manager rolling mill and heat treatment at Stahl Judenburg.*

cise geometry individually developed and produced for the customer. Here, the product development differs vehemently compared to other industries. Innovation is not driven by Mannstaedt but rather by the market itself. The customer usually asks the rolling experts at Mannstaedt for a very special contour, the latter then develop a rollable profile. So, the company is

happen several times a day. Thus, the CALIPRI RC220 is needed quite often. Apparently, it's frequent use made the purchase of a second device necessary.

Before CALIPRI was established, another product testing method was used at Mannstaedt – a very common method also widely used in other rolling mills. Product samples were cut off, cooled in a water

basin and then measured by hand with a caliper. This was a very time-consuming process which thankfully was a thing of the past since the development of CALIPRI RC220. Thereby, Martin Schütt praises the uniqueness of the gauge: "There are quite a few stationary systems out there that measure profiles in hot condition. But there was no flexible gauge for hot products before." Thus, the CALIPRI RC220 is as individual as the profiles that are produced at Mannstaedt.

## Prospects

Even traditional industries like steel are changing. Optimization and further development are all around. Common technologies are matter of improvement. One recent technological development is the profile gauge CALIPRI RC220 by Nextsense.

But where will the steel industry go from here? The experts of GMH Gruppe have the answer: "I think steel will remain one of the most important materials for machinery and automotive application", says Peter Sammt of Stahl Judenburg. "Well, speaking especially for Mannstaedt, the contours our customers need will definitely become even more individual and complex. And we are well prepared for this development", adds Martin Schütt.



Profile gauge CALIPRI RC220 in the field at Mannstaedt GmbH (Picture: Nextsense)

## Conclusion

Easy operability, highest precision and especially incomparable flexibility – that are the characteristics of the portable profile gauge CALIPRI RC220. An indispensable addition for rolling mills today, for high-

cise production of steel products for tomorrow.

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## MaSteel to modernize strip galvanizing line

**Ma'anshan Iron & Steel (MaSteel) has been investing in upgrading production facilities and has now awarded Fives a turnkey contract to revamp a continuous galvanizing line (CGL) to produce new quality coated products.**

The existing CGL No. 1 at the Ma'anshan-I site in the Anhui province of China is capable of producing 350,000 t/year of zinc coated products. Once revamped, the line will be able to deliver also ZnAlMg coated steel coils required in the household appliances and construction industries.

Fives will be responsible for coordinating and project managing the revamping project. The scope also includes the design and supply of a Stein horizontal furnace, as well as modifications of the after-pot cooling tower and a post treatment section which will be equipped with a new hot air dryer and air coolers. The project faces a double challenge: integration of the new furnace with a heat recovery system into the existing line and design of the specific equipment to meet new coating requirements. The project will be supervised by Fives' subsidiary in Shanghai, China, which

will be responsible for manufacturing of the furnace local portion and supply of its electrical and automation parts. The first coil is scheduled to be produced by the end of 2020.

Earlier this year, Fives was selected by MaSteel to design and tune its proprietary thermal optimization solution for a continuous annealing line (CAL) and a hot dip continuous galvanizing line (CGL No. 3) to maximize performance.

Fives



## Practical improvements in surface inspection

# Classifying defects more reliably

While AI-based technologies can now outperform humans in many categories of image processing, the “experienced” reliability of surface inspection systems in the steel industry often leaves much to be desired. In apparent contradiction to this, the very same systems are able to achieve high classification accuracy on controlled test data. A structured optimization of datasets and classifiers using deep learning technology drastically increases the practical performance of existing systems. For the best possible performance, surface defects must be classified multiple times throughout production.

Modern requirements for cold-rolled flat steel products necessitate ever-higher production quality, especially for applications in the automotive industry. Manual inspection through the complete production process is often not possible due to both cost and organizational restrictions. For this reason, large steel manufacturers are dependent on the use of automated visual surface inspection systems. These systems consist of cameras and illumination devices located above and below the steel strip, hardware and software for defect detection and classification, as well as a software interface for the user. The correct classification, i.e. the determination of an image’s surface defect category, is the critical operational piece of the system. This classification itself is ultimately what enables the system to, for example, distinguish non-metallic inclusions from superficial dirt.

Typically, the manufacturers of the surface inspection systems follow the steps of installing the systems on-site, optimizing the classifiers, and training future users. After acceptance, factory staff is then responsible for further optimization of these systems, with occasional support from system manufacturers. Frustration concerning poor classifier performance is often directed towards these internal employees, despite that they have tuned the classifiers optimally given their information constraints. To make matters worse, the technologies behind the operation of these classification systems are trade secrets of the inspection system manufacturers and only the most rudimentary optimization tools are made available for use. Making improvements to the identified weak points of the systems is practically impossible in many cases.

Both the surface inspection system manufacturer’s specifications and scientific

literature give consistently high values for classification accuracies. Often, accuracy levels of 95% or more are declared. However, the employees who are responsible for quality control find that, in production, the classification results tend to be much more unreliable.

In the following section, the most important reasons behind this discrepancy are explained and possible solutions are presented. Smart Steel Technologies (SST) offers a wide range of software tools that significantly improve classification performance in practice without the need to replace existing inspection systems consisting of expensive integrated imaging systems (**figure 1**).

## Training and test sets

To build a classifier that can properly classify all types of surface defects, training sets and test sets that contain represent-

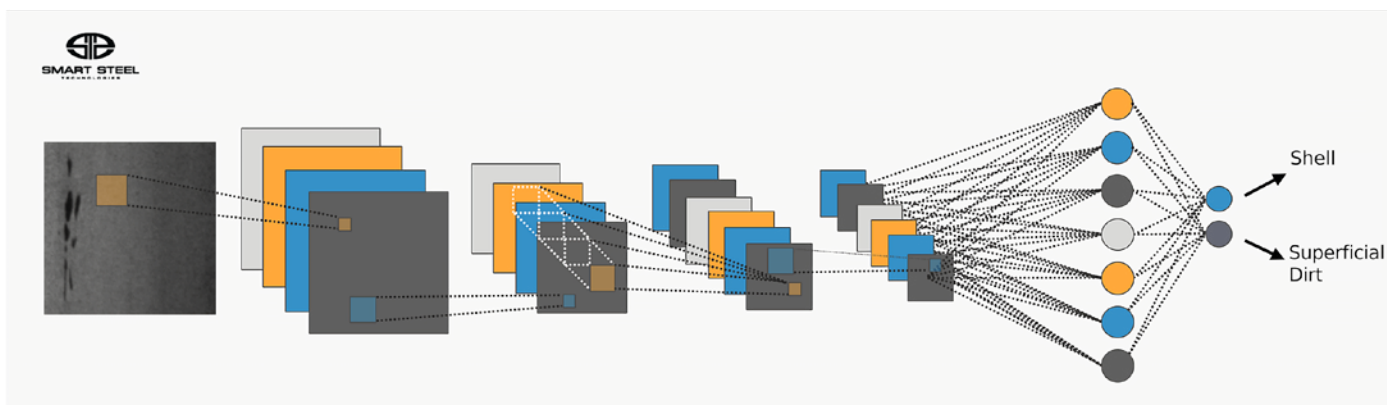


Figure 1. Deep learning technology is superior to conventional methods of surface defect classification (Picture: SST)

Authors: Dr. Falk-Florian Henrich, Founder and CEO; Dr. Otmar Jannasch, VP Metallurgy; Dr. Jan Daldrop, Machine Learning Engineer; Selim Arikan, Machine Learning Engineer; Matt Fabina, Director of US Operations; Smart Steel Technologies, Berlin, Germany – Contact: [henrich@smart-steel-technologies.com](mailto:henrich@smart-steel-technologies.com)

ative images of all relevant defect types are required. The classifier is then trained using the images in the training set, and the classification performance is validated by the images in the test set.

Individual surface defect types on hot and cold rolled strips come in a variety of shapes and structures. At the same time, disparate defect categories (e.g. shells and scratches) sometimes have similar appearances and visual characteristics. Additionally, if individual variants (subclasses) are missing in the training set, they are not reliably learned and detected by the classifiers.

The physical appearance of defect images depends on many metallurgical factors. One example is the steel grade of a coil, which directly affects the visual characteristics of both the steel surface and the actual defects. Additionally, factors such as the environmental conditions of the cameras (e.g. dampness, condensation, dirt) may affect the visibility of the defect in the images. Ideally, each defect category should be represented by images captured in each of these environmental variations.

Another important aspect of training set construction is the selection of images over an extensive production period. A typical confounding effect is a concentration of images for a defect category among only a few coils. When a classifier is trained using this unbalanced and biased data, there is a danger that the classifier will “learn” the characteristics of the defect only within the specific context of the few sampled coils.

When training and test sets are sampled from an overly-homogenous data set, the validation accuracy of the classifier on the test data is artificially inflated. If for example, exceptional visual cases are missing in the training set, the classifier will have never been exposed to them. One way to mitigate this effect is to use random samples of images for both the training set and test set. However, this naive randomization may introduce unintended consequences. For example, if in this random scheme a classifier is by chance only shown oil flecks on certain steel grades, it may naively associate oil stains with visual characteristics related only to those steel grades. The classifier would also perform artificially well on such a test set since the training set and test set would be ran-

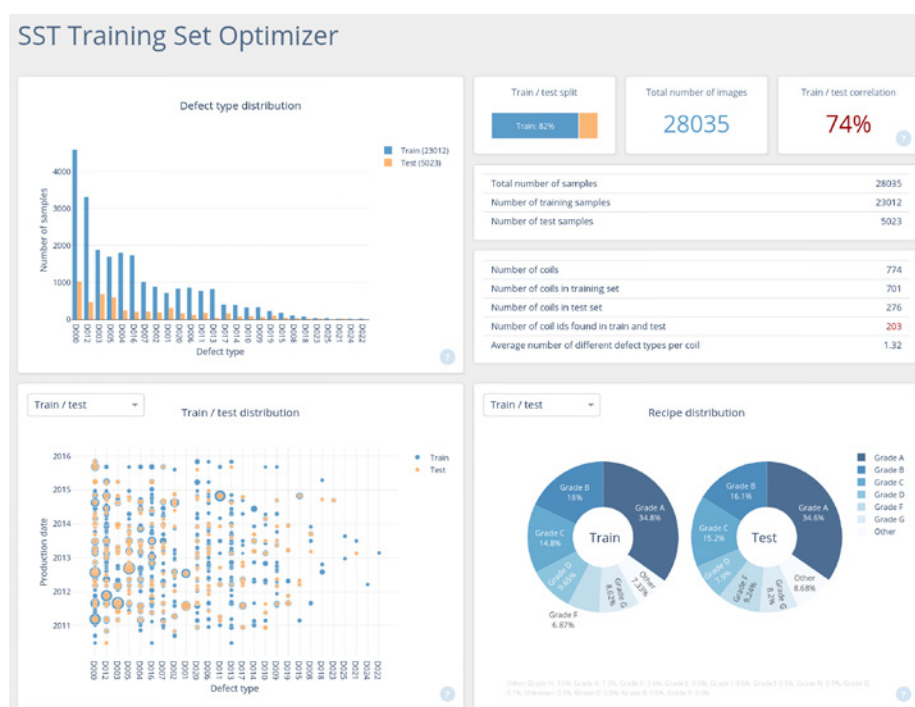


Figure 2. The SST Training Set Explorer can be used to create high-quality and representative training and test sets (Picture: SST)

domly sampled from the same base dataset. This phenomenon poses a major problem in practice. Real-world cases of training set and test set splits have produced classification accuracies of up to 80% using only the metadata associated with the defect image, such as steel grade and production time.

Even though the classifiers in these examples may achieve high accuracy levels in the validation phase, this performance will fail to be reproduced under real, long-term production conditions.

Last but not least, the size of the training set is a decisive factor for classification accuracy. Yet, in practice, many training and test sets are relatively small. Investing time and effort to create a large dataset is always worthwhile, especially when modern classifier technologies are used, as they can capture both the large variance within classes and the subtle differences between different defect types.

Smart Steel Technologies has developed several software tools for properly creating effective training sets and test sets. The SST Training Set Optimizer (figure 2) is a statistical analysis tool that monitors the composition of training sets and test sets, enabling the efficient addition of defect images. In addition to the class distribution, the chosen production period and steel grades per class can be

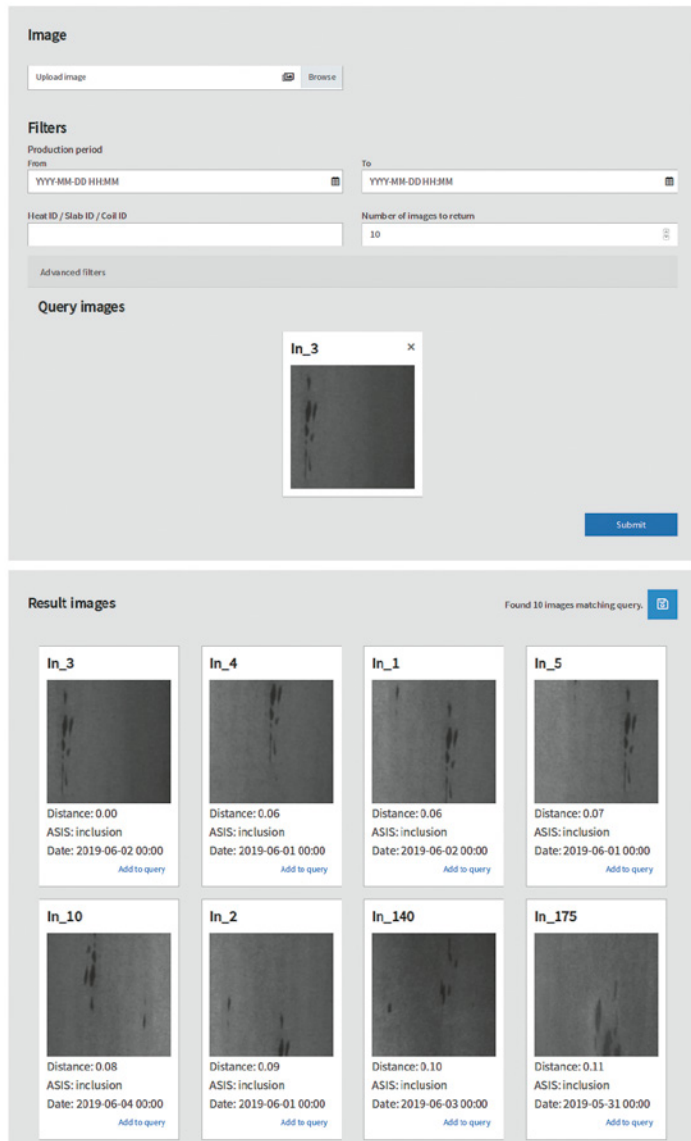
monitored. A train-test correlation is automatically calculated based on metadata. Instead of evaluating the datasets by naive statistics (e.g. total number of images), a comprehensive overview of the training set and test set condition is presented instead, including potential steps to take for improvement of classification systems.

To quickly find and identify suitable images to training sets and test sets, Smart Steel Technologies has developed a deep learning based image search engine (figure 3) that allows millions of defect images to be searched for visual similarity in fractions of a second. Using the built-in filters for specific steel grades and production periods, hundreds of images can be found and added to the training or test set within a few hours. The image search effectively finds suitable defect images even for the rarest surface defects.

## Defect distributions

There exists a natural, significant class imbalance in steel production: some defect image categories such as pseudo-defects or superficial dirt occur very frequently, while more severe defects are relatively rare. Classification systems must be able to effectively identify the few truly





**Figure 3. With the deep learning based SST Image Search millions of defect images can be searched in fractions of a second** (Picture: SST; Example defects: NEW dataset [10])

severe defects in the relatively large corpus of images.

To illustrate the problem, consider a classifier that correctly classifies shell defects against other defects with a 90% probability. Applied to 1,000 defect images of a coil that contains 50 shells, such a classifier would report only 45 correctly as shells. Applying the 90% probability to the remaining 950 images that do not contain a shell would yield 95 “false positive” shells. In total, such a classifier would assign 140 images to the shell category, of which only about one third would correctly be in the shell defect category. The user now has a reasonable impression that the classifier does not work.

that measured performance values are matched in production. However, the accuracy measure of a classifier on such a test set would not reflect the performance of the classifier with respect to rare and severe defects, though it is exactly these rare and severe defects that are often the central focus of classification systems. As a rule, a compromise between the two extremes is recommended: test sets should represent both defects that are frequent in production as well as those that are metallurgically relevant. The test set should also challenge the classifier to the extent that improvements in accuracy can be detected when further training data is added. With the assistance of the SST Training Set Opti-

Such a system would detect severe defects for nearly every coil, triggering a mandatory manual follow-up inspection process. The problem cannot simply be solved by changing the sensitivity thresholds for classification to reduce false negatives, as the accuracy (precision) is always increased at the expense of the sensitivity (recall). Insufficient recall, however, means that serious errors may not be detected and defective coils are released as a result.

The defect distribution of the test set must be chosen carefully. Consider that the test set should mirror the distribution of production in order to increase the likelihood

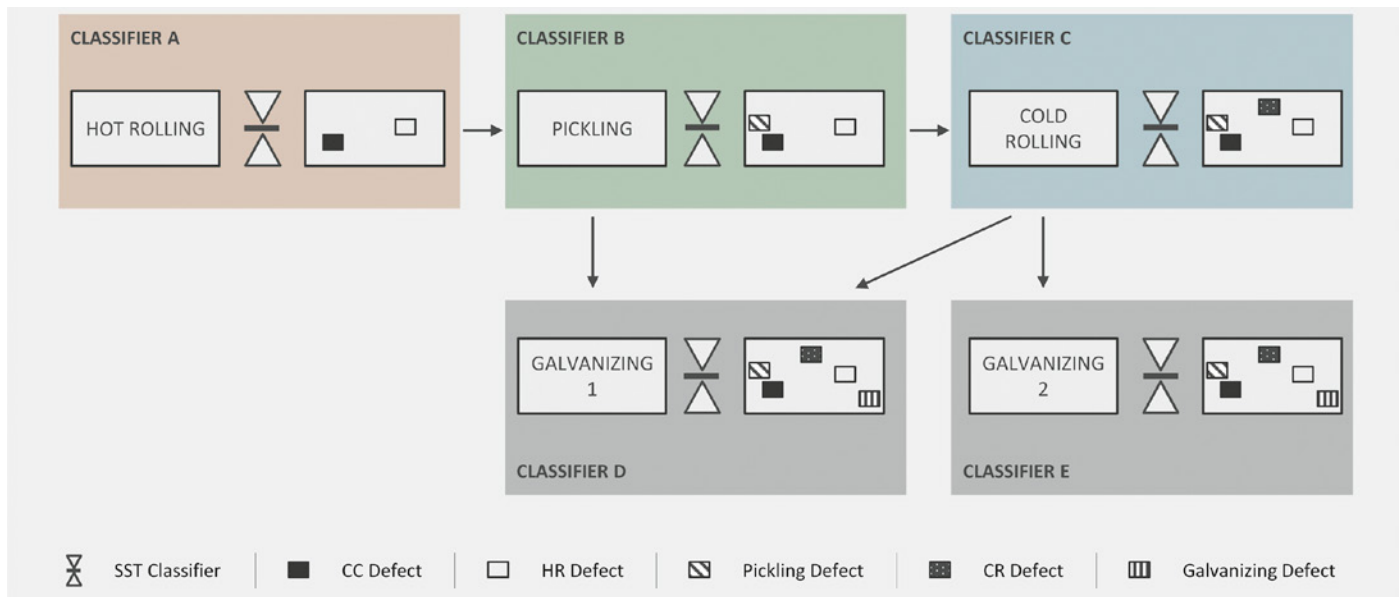
mizer, such an effective test set can be generated. These test sets can then be used to realistically assess the classifier performance in production.

## Classification technology

A well-performing classifier is the most critical element of a reliable surface inspection system. Typical surface inspection systems only make use of conventional classifiers which extract manually-designed features for use during classification [1]. These features are optimized for use on many different materials such as paper, glass, fabric, steel, foil and plastic. If surface defects differ due to a property that is not mapped within this relatively limited feature set, such defects cannot be distinguished by the classifier. Furthermore, the features are often considered as trade secrets and the manual addition of features is simply impossible.

After the publication of the AlexNet architecture in 2012 by Krizhevsky, Sutskever and Hinton [2], which has since been cited by over 40,000 scientific publications, a new era of image processing began. Deep neural networks achieved 85% top-5 classification accuracy in the ImageNet Large Scale Visual Recognition Challenge, over 10% more than traditional image recognition systems. The latest deep convolutional neural networks (CNN) achieve a top-5 accuracy of up to 98% in the same benchmark, a performance that is superior to human test subjects. Due to CNNs’ unprecedented success in the ImageNet challenge, it should not come as a surprise that they also provide significantly higher classification accuracy levels in steel surface inspection than the conventional methods described above [4 – 9].

Smart Steel Technologies uses deep learning technology for automated surface inspection and precise defect classification on GPU servers. The company has been developing custom-built CNN architectures for classification of steel defects for several years. These deep learning systems are often more than 10% better than traditional systems on the same training and test data. The software can be integrated directly into production with read-only access to the databases of an existing surface inspection systems without any need for expensive hardware upgrades. The clear advan-



**Figure 4.** With SST software for material tracking, the surface inspection results of different production lines are brought together in precise positions (Picture: SST)

tage of this approach is the quick and cost-effective improvement of these existing systems. The classifier performance is evaluated and optimized in close cooperation with the customer during production.

Furthermore, unlike many traditional methods, the increase in data volume when using deep learning technology frequently leads to an improvement in the classification result. While users of classical systems sometimes find it frustrating when no improvement of the classification is observed after adding a larger amount of data, deep learning systems can always be improved by the addition of training data. In order to alleviate a deep learning classifier's confusion of two similar defect categories, it is often sufficient to simply increase the number of representative images of those two categories within the training set.

### Various production lines

In most plants, multiple independent surface inspection systems can be found along each production line (**figure 4**), and in some cases, provisioned by multiple suppliers. While a few manufacturers have made efforts to compare performance across plants and production lines, many surface inspection systems are evaluated completely independently. In particular, classification systems within a single plant do not communicate with

other upstream or downstream classification systems. This lack of communication prevents feedback loops that would improve classification results, for example, one system communicating high-probability shell defect classifications to a downstream production line. Additionally, global coil information, e.g. that a high rate of non-metallic inclusions was observed on a certain coil in a previous processing step, improves classification in later production lines.

Smart Steel Technologies offers flexible material tracking software that

allows combining inspection results from different systems even in extreme cases. The defect positions are accurately superimposed taking into account strip position transformations, cropping and trimming shears as well as the cutting and welding of coils (**figure 4**). This enables the detected defects of all relevant surface inspection systems to be viewed together in one central coil map, as well as the SST classifiers to access the inspection results of upstream production lines, resulting in improved classification results.

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## Strip processing lines

# Advanced mechanical equipment for the 3rd generation AHSS

In the past 50 years, steel grades for automotive applications experienced several revolutions and transformed from mild steel to the 3rd generation of advanced high strength steel (AHSS). With the development of new grades, steelmakers and equipment suppliers are facing new issues and must decide about investment either in a new line or in an actual line revamp. The new design of mechanical equipment enables to achieve necessary metallurgical requirements (annealing temperature, cooling rate, skin-pass elongation), to thread the line and to transport the AHSS strip along the processing line without damages.



Figure 1: Fives and Baotou Iron and Steel Group commissioned two complete continuous galvanizing lines NeoKoil® (Picture: Fives)

Steelmakers are now at a new breakthrough point of steel development with introduction of a grade up to 1,800 MPa for automotive applications to achieve weight lightening or safety requirements. To design a processing line, strip mechanical properties are key input to validate equipment choice and line configuration. New steel grades have an impact on shears and threading capabilities, strip transportation before and after annealing, skin-pass and tension leveller characteristics. Mechanical equipment for advanced high strength steel with high tensile strength and high formability should be designed by using engineering experience of line design for stainless steel production.

Therefore, a new range of equipment has been developed in order to satisfy new requirements and to ensure strip threading, anticipate bending and tension control, improve flatness and implement the fine tuning of mechanical properties. Fives has designed a NeoKoil® strip processing line (figure 1) for carbon steel and integrated the state-of-the-art solutions based on its know-how in stainless steel:

- DMS OptiLine™, a unique and precise software tool to anticipate bending and tension control specificities,
- new threading equipment and a concept to ensure an entry cycle,
- new design for skin-pass mills and tension levellers for high elongation on AHSS,
- new design for side trimmers and scrap evacuation systems.

## Threading equipment

The entry section of the strip processing line for the 3rd generation grades faces an

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Figure 2. Flattener for the 3rd generation grades (Picture: Fives)

issue that was considered to be solved long time ago: introduction of the flat strip at the entry shear. Our study for mechanical equipment to produce the 3rd generation grade shows that a threading flattener needs specific design as shown in **figure 2** to support additional constrain to straighten the strip. To avoid roll deformation, stiffeners are to be installed to succeed proper threading.

### Bending and tension control

Strip mechanical properties impact strip transportation design not only regarding tension requirements for a skin-pass mill and a tension leveller, but also roll angle losses, as well as energy consumption for strip bending with consequences on bridle configuration, strip guiding and electrical consumption. In order to meet the require-

ments of new steel grade production, Fives developed DMS OptiLine™, a precise software tool, which simulates the complete running of a strip processing line. It calculates the requested characteristics of each motor of the line based on the tension map request and mechanical properties received from upstream facilities and targeted at line exit. It guarantees the required line tension during operation at the constant speed, as well as during line acceleration and deceleration. Accumulators are also checked according to the real product mix of the line.

The DMS OptiLine™ is designed to achieve the best possible performance by anticipating every operating scenario and offering appropriate responses:

- anticipate quality risk linked with strip driving to prepare development of new grades or new strip dimensions,

- optimize need of change (motor, bridle, pinch roll) during a revamping project.

The production is simulated as shown in **figure 3** with a line speed variation, strip dimension changes and a grade transition phase. This insight can significantly reduce the time taken for commissioning.

### Skin-pass and levelling

Steelmakers' needs concerning skin-pass and levelling equipment remain the same for the advanced high strength steels: erase yield point elongation, adjust yield strength and apply roughness on the strip. Taking into account the grade range increase, we must be able to install a skin-pass mill with flexibility to cover yield strength from 100 MPa to 1,700 MPa (**figure 4**). For this, rolling and bending forces, stand and roll dimensions have been

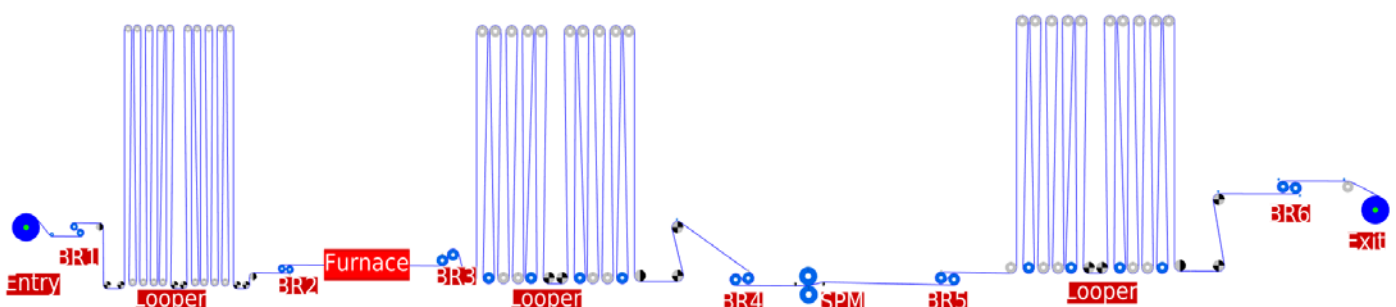


Figure 3. DMS OptiLine™ modelling results (Picture: Fives)



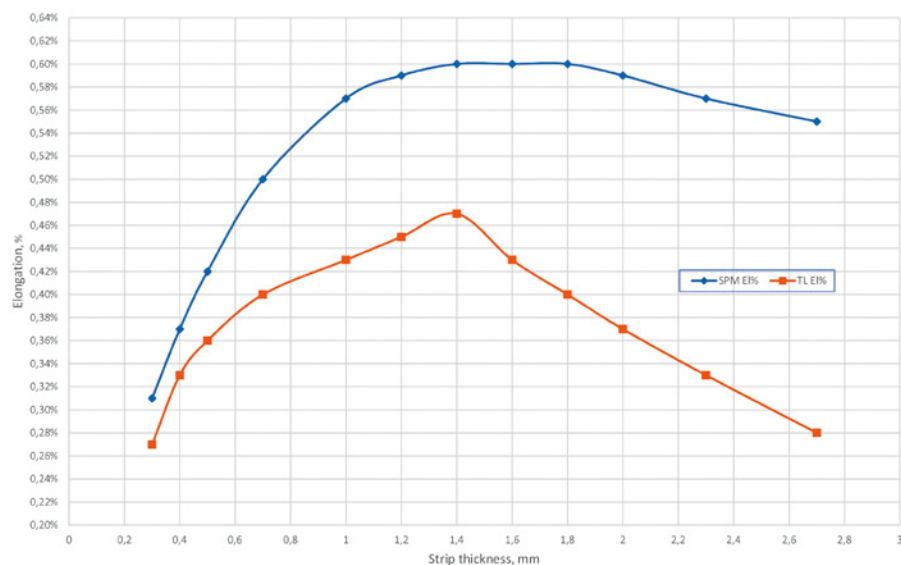


Figure 4. Elongation capability for 1,400 MPa grade (Picture: Fives)



Figure 5. DMS StripLeveler cassette (Picture: Fives)

rechecked and validated by model calculation.

Skin-pass stand design covers:

- high rolling force up to 1,800 t,
- high bending block capacity,
- capability to use two work roll diameter,
- optimization of environment footprint with either a spraying system adjustable according to the strip width or a close circuit for detergent wet rolling.

To achieve this new challenge, levelling equipment must be able to run with high tension without cassette bending even for wide dimensions. The tension leveller equipment is to be designed for a strip tension up to 100 t for either dry or wet rolling with a hydraulic or electrical cassette adjustment.

Fives has developed the DMS StripLeveler (figure 5) which features an elongation system made of two dual-bending units that eliminate flatness defects on the strip through a slight elongation of 1-2%. The thin cassettes braced by a large supporting frame provide maximum stiffness, which, coupled with the machine's advanced control system, enables a uniform and accurate elongation across the entire width of the strip.

## Conclusion

Production of the 3rd generation steel grades on processing lines needs a global re-engineering of mechanical equipment and standards that have been defined in the past 30 years. Today, the new design of mechanical equipment enables to achieve necessary metallurgical requirements (annealing temperature, cooling rate, skin-pass elongation), to thread the line and to transport the strip along the processing line without damaging it to produce advanced high strength steels.

## ArcelorMittal Long Products Canada acquires Legault Métal

Through the acquisition of Legault Métal Inc., ArcelorMittal Long Products has extended its presence in the Quebec scrap recycling market.

Legault Métal will continue to deliver its services to scrap dealers and individuals under the same name as a division of ArcelorMittal. "As the largest

recycler of scrap for local use in Quebec, we are further securing our supply of raw materials from this region and strengthening our value chain," says François Perras, chief executive officer of ArcelorMittal Long Products Canada.

Gerry Legault will support the ArcelorMittal Long Products Canada team to

ensure a smooth transition of operations over the coming months. The approximately 100 people who are currently working for Legault Métal remain employed by the company as of the transaction date.

■ ArcelorMittal Long Products Canada

## Austrian energy project successfully completed

# Wuppermann Austria receives “Energy Audit plus” for considerable energy savings

Wuppermann Austria was able to achieve major energy savings by implementing three important measures. As a result, the company has reduced annual energy consumption by 1,742.69 MWh during the E-LEEN project.

For 4 years, steel strip processing company Wuppermann Austria has been contributed major energy savings within the E-LEEN initiative. Supported by the regional energy company Energie Steiermark AG, E-LEEN is a network for energy efficiency with particular focus on facilities and transport. The joint initiative of several companies and the State of Austria had formulated an overriding goal for all participants, whereas every member specified individual targets for energy savings. The duration of the project was set from October 2015 to June 2019.

“Our target was to reduce annual energy consumption by 1,459 MWh for the period of the project,” says Josef Koini, energy commissioner and E-LEEN project manager at Wuppermann Austria GmbH. “At 1,742.69 MWh per year, we exceeded this figure. Thus, we contributed 9.8% to the overall target.”

The objectives of the E-LEEN initiative included key issues to be implemented in terms of energy saving. The individual measures of these key issues were organised and coordinated by the participating companies. Thus, Wuppermann Austria was able to achieve the three largest savings with measures as following:

- renewal of the cooling air fans (319.85 MWh/a),
- induction heating of the strip galvanizing line 1 (498 MWh/a) and
- hot water generation by means of a heat pump (711.8 MWh/a).

Many smaller savings could be achieved by replacing the lighting in various buildings and, in total, made a significant contribution. In terms of annual energy consumption, this represents a total saving of 8.2%.

For the network participants, an “energy audit plus” was prepared in accordance with the Federal Energy Efficiency Act (EEffG) of the Republic of Austria §18 in order to meet the requirements of this Act on the one hand and to achieve actual and

### Wuppermann: steel processing for over 145 years

Wuppermann Group is a medium-sized family business based in Leverkusen, Germany. Wuppermann Austria in Judenburg is one of the five production sites within the Wuppermann Group and one of the largest employers in Styria. Here, the company produces narrow, galvanized slit strip as well as galvanized tubes and profiles. It specialises in high corrosion protection with coatings of up to 1,200 g/m<sup>2</sup> (zinc) and 1,000 g/m<sup>2</sup> (zinc-magnesium), in particular for applications in construction and in the solar industry.

sustainable energy savings on the other. The EEffG came into force on 1 Jan 2015. Considerable energy suppliers are obliged to take efficiency measures for themselves and their customers or other energy consumers or to make a corresponding compensation payment (supplier obligation). The energy saving measures of the individual participants were monitored in advance by the Monitoring Agency of the Austrian State. All measures taken by Wuppermann Austria GmbH were recognised in this process.

Despite the success in terms of savings, Wuppermann Austria does not want

to rest on its laurels, but is convinced that it will find further potential. The effort is worth it: energy efficiency has tangible ecological and economic advantages and is becoming increasingly relevant in the steel industry. For this reason, a second run of the E-LEEN network was to be launched in autumn 2019. The energy audit will examine where further energy measures can be implemented as successfully as before by Wuppermann Austria GmbH.

■ Wuppermann AG, Leverkusen, Germany

Production facilities of Wuppermann Austria GmbH in Judenburg (Picture: Wuppermann)



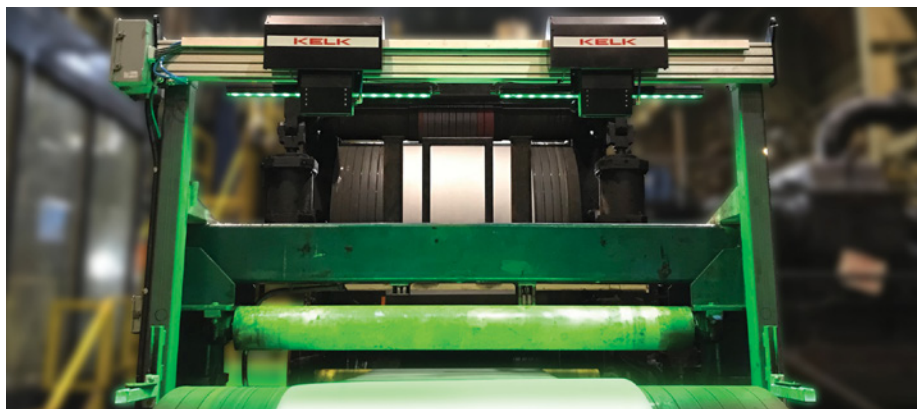


## Accuband strip width gage for cold rolling steel mills and processing lines

The KELK brand of Vishay Precision Group, Inc. introduced the ACCUBAND strip width gage model C775-FF for cold rolling mill and processing line applications. The gage provides steel mill operators with continuous, stereoscopic, non-contact material width measurements in cold rolling mills and processing lines.

The width gage includes four CCD cameras, arranged in fixed pairs, to scan steel strips at a rate of 1,000 scans per second in order to accurately locate the position of the edge, regardless of pass line variations. The edge data is then combined with the camera separation distance, obtained during calibration, resulting in accurate strip width and centerline deviation.

The compact design of the ACCUBAND C775-FF allows the width gage to be installed in tight spaces while still providing one of the most accurate measurements in the industry ( $\pm 0.4$  mm at 2 sigma). In addition, integrated LED front light illumination provides long life, reliable performance, and minimal maintenance.



Accuband C775-FF cold strip width gage (Picture: KELK / Vishay Precision Group)

The new ACCUBAND C775-FF joins KELK's current model ACCUBAND C765-F cold width gage and ACCUSPEED Laser Velocimeters, to provide additional solutions for cold rolling mills and process lines. Movable cameras on model C765-F automatically position themselves over the edges of the strip, based on the nominal width input, to provide accurate width measurements, whereas cameras on the new model C775-FF are pre-positioned, making the system more compact, to fit into tight

spaces, and easy to maintain, by eliminating moving mechanical parts.

In addition to cold strip mills and processing lines (including galvanizing and pickling lines), other specific applications for the ACCUBAND C775-FF include tension levelers, side trimmers (entry and exit), tandem mill exits, temper mills, and slitters/rewinders.

**KELK** – a brand of Vishay Precision Group, Toronto, Ontario, Canada

## New work roll bearings significantly increase service life

**NSK has developed a four-row sealed tapered roller bearing with water resistant grease.**

The tough environments found in hot rolling mills require components that can withstand the challenging conditions as well as contribute to keeping cost and energy consumption down. New work roll bearings for rolling mills from NSK offer greater reliability and longer service life.

The NSK work roll bearings are packed with a newly developed grease that extends service life even under severe conditions, including water inclusion. The new grease composition offers a thicker oil film and protective layer between the raceway and rollers. Grease additives also inhibit corrosion which boosts the service life in conditions where water has potential to enter the bearing.

The newly designed sealed bearing offers two benefits. With an optimized internal design, an increase in load rating

is achieved. Additionally, the improved seal design inhibits water from entering the bearing which can reduce contamination of the grease and improve bearing performance. With these two significant improvements, real world test validated dramatic gains in bearing service life. For example, bearings in a specific mill are now achieving 16 months service life compared to conventional bearings typically lasting less than 8 months.

Increased service life equates to higher operational reliability, fewer replacements and reduced downtime for repair. Longer service life also reduces material and ener-



Four-row sealed tapered roller bearing for hot strip mills (Picture: NSK Americas)

gy consumption (including CO<sub>2</sub> emissions) relative to the replacement cycles of conventional models.

**NSK**, Ann Arbor, Michigan/USA

## PSImetals Service Platform

**PSI Metals has successfully launched the PSImetals Service Platform at METEC 2019, the international metallurgical trade fair taking place in June 2019 in Düsseldorf, Germany. The Service Platform is the new powerful software basis that combines all requirements for a future-proof production management solution for all currently available PSImetals components as well as new services that will be developed in the coming years for metal producers.**

The PSImetals Service Platform features an integrated service bus (PSIbus), which is responsible for the entire data exchange between PSImetals services and third-party services/products. The proven PSImetals Factory Model, the digital twin, is still the heart of the new platform and will operate on all industry-proven database management systems for future services. In addition, an old-timer bus exclusively acquired for METEC 2019 as a physical reference to the service bus represented the development towards digitalization of met-

als production. Several showcases inside the old-timer demonstrated PSI's innovations in the fields of machine learning, service-oriented architecture, artificial intelligence and virtual reality.

Technical presentations of PSI experts during the parallel conferences European Steel Technology and Application Days (ESTAD) and European Metallurgical Conference (EMC) backed up the participation.

■ PSI Software AG, Berlin, Germany

## Advanced features for gunning machines and pneumatic conveying installations

**As novelty VELCO presented at METEC 2019 a remote access module for their machines. The access is given through a specific cloud service.**

The control cabinets of all VELCO machines can optionally be equipped with the new remote access module which allows to call worldwide for machine data, e.g. operation hours, flow rates, water pressure, operational condition, fault messages and even the location of the machine. The access is given through a cloud provided by VELCO. For the machine only a country-specific SIM-card at the place of use is needed to get access – simply with a smartphone, tablet or PC. It offers advantages as following:

- information about machine status and operation hours,
- quick fault diagnosis by the support staff,
- cost-effective – as only small data volumes are exchanged,
- no interference of the company network (data protection).

Based on prior verification, the VELCO remote access module can also be retrofitted to existing VELCO machines and machines of other brands.

### Hot repair of refractory linings

Visitors of VELCO's booth showed also big interest in gunning technique for the quick hot repair of the refractory lining. Today the hot gunning repair of aggregates (converter, ladle, EAF, RH-snorkels etc.) is a cost saving alternative to the shut-down and renewal of the complete lining. This

process increases the service life of a furnace considerably and it further results in savings of re-heating energy. Due to the quick repair, the number of circulating aggregates, e.g. ladles, can be reduced, too. Moreover, the accident risk is reduced. However, melt shops are not identical. VELCO offers the customized solution for each aggregate, being a fix installation, crane-moved or mobile unit.

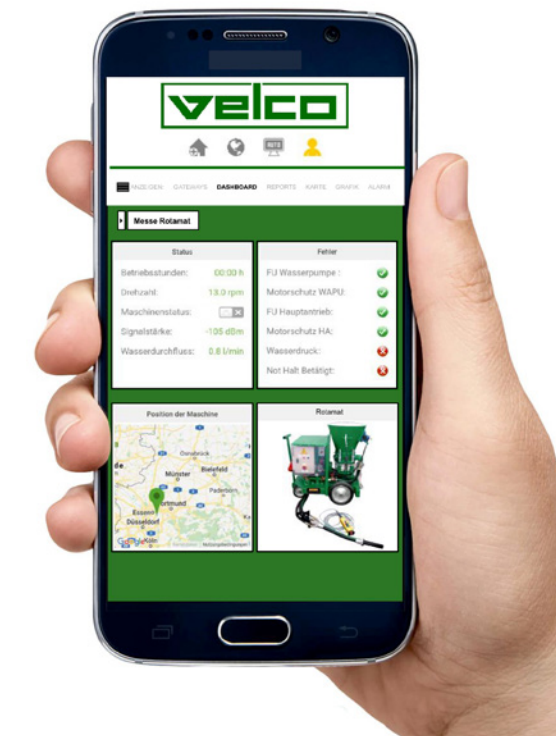
### Pneumatic systems for injection and conveying of bulk materials

Besides the well known gunning machines and gunning manipulators VELCO presented also pneumatic conveying installations for dry bulk materials. Here the pneumatic injection system type UNIDOS found special interest. In steel plants it is used for injecting carbon for the foaming slag process and for the addition of lime and other secondary-metallurgical treatments.

Nowadays, with regard to ecological and economical aspects, it is also used to blow-in filter dust. For materials that flow poorly and agglomerate easily, VELCO offers the UNIDOS-R model which is equipped with a special agitator in the chamber substructure.

UNIDOS is also a proven system used in blast furnace operations, where carbon powder, iron ore, filter dust, Rutilit, Ilmenite and even plastic shredder material are fed into the furnace.

EAFs with EBT can be equipped with an automatic installation for the addition of tap hole filling sand. The exact needed quantity of sand can be given either semi



Remote access via smartphone, tablet or computer (Picture: VELCO)

or fully automatically onto the EBT. This procedure reduces the standstill times and the danger of accidents.

For coarser bulk materials or materials with higher humidity, VELCO offers its machine type EKS with mechanical dosing system. All machine types can be provided as multiple dosing devices with several, parallel outlets.

■ VELCO, Velbert, Germany



**Dillinger makes your plates talk to you**

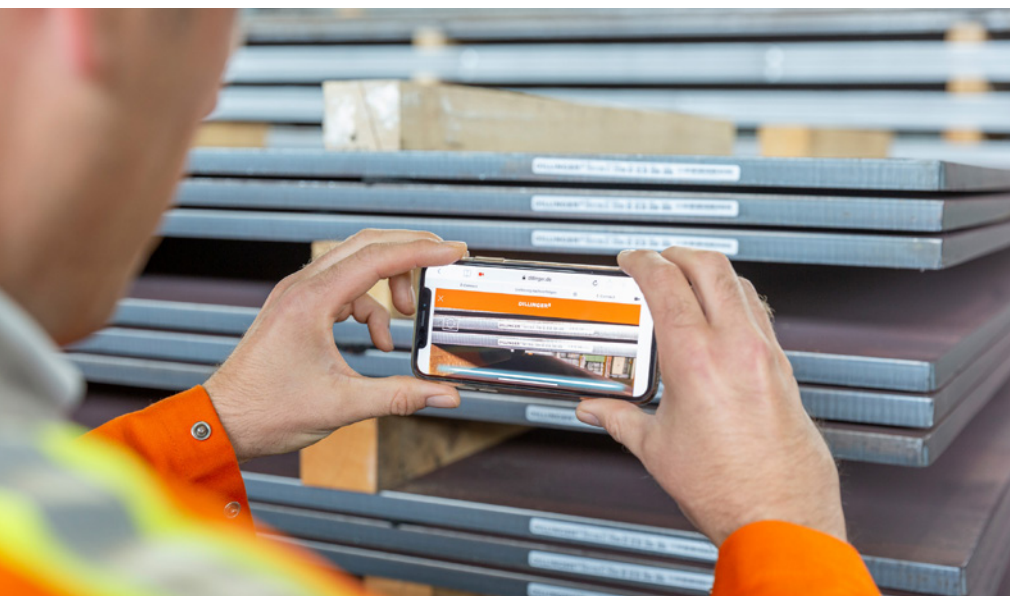
## Plate processing à la carte – via smartphone

Dillinger is working at full throttle on the digitalisation of its value chain. The company is backing design-thinking processes in innovation management to meet its customers' needs as efficiently as possible. The first fruit of this development method is the E-Connect app, which provides customers with immediate, plate-specific information at the swipe of a barcode. The user can interlink this data on the with a large range of services and calculation tools available on the higher-level E-Service platform.

Working with Dillinger has never been as convenient as now: at the push of a button, the customer is given valuable information, around the clock - with no waiting times, and anywhere in the world. This steel producer, a global quality and technology leader, is unceasingly searching for new and better

them in selecting the best grade of steel for their needs. Feasibility checks and notes concerning possible additional requirements, such as ultrasonic inspections, thus transform the extensive delivery range into a tailor-made program. In addition to their delivery history, customers also have all relevant order data, such as

of top-quality Dillinger steels. The benefits of this platform, which can also be accessed while travelling, using a smartphone or a tablet, for marketing/sales teams, stockholders and steel users are readily apparent: thanks to access to their own individual, continuously refreshed data, irrespective of time and location, they are always up-to-date. In the case of orders, for instance, divergences such as delays – and also pre-deadline completion! – thus make communications and planning changes possible at an early stage. In addition, time-consuming searches for the information needed, followed by printing-out and copying of documents, are now a thing of the past. This relieves employees of tiresome administrative tasks, accelerates implementation and minimises the risk of transmission errors. For steel users, not only the planability of warehousing and production processes, but also productivity, are boosted.



**Customers of Dillinger receive specific data from the original certificate (as a PDF file) via scans of the barcode** (Picture: Dillinger)

solutions, to proactively fulfil customers' expectations. For this reason, the company consistently exploits the potentials of digitalisation, always aiming to optimise cooperation using new services. The basis and central element in this is the E-Service customer information platform, which is also configured for mobile terminal devices. This intuitive tool on the Dillinger website gives steel stockholders and users immediate access to all the relevant data on all aspects of their orders – in German, English or French. A Product Finder assists

invoices, inspection documents and certificates at their disposal for download at any time. Thanks to the simple-to-use search and sort functions, material analyses, standards, specifications and all approvals can be found here quickly and easily.

The E-Service platform's service package is rounded off by a series of high-performance calculation tools for welding characteristics: carbon equivalent, preheat temperature, hardness in the heat-affected zone during welding, etc., can thus be obtained directly for working and welding

### Groundbreaking connection between plate and smartphone

Dillinger has now expanded this useful E-Service kit with another module: the E-Connect app now also immediately provides the customer with a plethora of plate-specific information. When the customer scans the barcode on the plate in front of him using a Smartphone, he receives not only the specific data from the original certificate (as a PDF file) for that plate, but also general order information, the results of the inspections and tests performed, and the chemical analysis data. The customer can then export this data in machine-readable formats, such as CSV, XML and JSON, or use the link provided to connect it to the tools available on the E-Service portal. The immediate availability of this data, of great relevance for the entire goods-reception and production process-

es, means significant time-savings: the search for the plate number and the appurtenant data in a mountain of papers is now superfluous, as is the necessity for on-site measurements and calculations.

The customer can also immediately use the dimensions obtained by scanning the barcode, and sort the plates, even while they are being unloaded, by heat, order, thickness, width and mechanical strength, to accord with his production planning. In addition, the reference number enables him to check the plates straight into his system at goods-reception and to thus assure all-inclusive start-to-finish material tracking in his production process. Thanks to the certificate data, yield strengths and mechanical-strength data obtained from the barcode, and using the characteristics data calculated using the app, he can also immediately optimally adjust his welding system, with correspondingly low tolerances in the end product.

Not least of all, precise advance knowledge of the plates' material properties shortens the start-up phase and thus boosts not only quality but also productivity. The barcode is normally applied to the front and rear faces of the plate, with the result that it can be accessed even when the plate has been partially used. The plate markings assure access to the required information in cases in which the barcode is missing or has been damaged. Dillinger can also provide customer-specific barcode configurations if required.

### Joint product development with customers

The E-Connect app runs with all browsers, and thus on both iOS and Android devices. It can be loaded via the Dillinger website, and does not need to be downloaded from an app store, and is therefore automatically always completely up-to-date. For smaller companies, in particular, Dillinger has thus installed an additional service screen: in addition to direct communications with their personal Dillinger contact, they can now view all information on the plate currently being processed at any time. In order to guarantee genuinely high benefits and user friendliness for the app, Dillinger's Innovation Management team put its faith during the development phase in customer-focused design-thinking methods. Problem situations from customers' everyday work were discussed in supra-departmen-

## AG der Dillinger Hüttenwerke

Every year, Dillinger produces some two million tonnes of heavy plate for severely loaded machines and structures in key industries – in an unparalleled range of thicknesses and formats. The high-performance materials – the majority of which are less than ten years old – are produced for applications that demand extreme durability under the most adverse conditions of service. The company, together with its subsidiaries, is the leading European producer of heavy plate and, as such, is established and active on a global scale. Thanks to their precision and quality, Dillinger products are a byword for total reliability. The company combines this outstanding reputation with an integrated range of services and complex plate-fabrication operations.

tal workshops, in order to jointly find precisely tailored solutions. The specific ideas thus evolved were presented to the users in the context of on-site customer forums and individual workshops at every development stage, in order to permit incorporation of the feedback from practitioners into the continuing process. The E-Connect app, the first product developed in this way in close cooperation with customers, therefore answers a market need which conventional solutions have up to now not been able to satisfy.

### Digitally networked partnership

Dillinger also intends to pursue this path together with its customers in the future: a successively expanding digital portfolio on the web portal is to make interaction with customers ever more transparent, ever more efficient and ever more flexible.

In future, customers will be able to communicate securely with their trusted Marketing/Sales contact using the new, central communications route, irrespective of

working hours, and with no use of paper. The next milestones on Dillinger's course are already coming into view: tracking of plates from production through to the agreed destination will be possible in the near future. Also conceivable is that, at a later time, the machine reads the barcode directly, or that claims can be communicated in a time-saving manner by app to the responsible marketing/sales employee using a barcode and a photo of the point in question on the plate. The E-Service portal and the E-Connect app embedded in it thus mark for Dillinger the start of a digitally networked, future-orientated partnership, by means of which the steel producer tangibly reduces the increasing complexity of the globalised world for its customers.

*Dillinger Group, Dillingen/Saar, Germany*

**Using the characteristics data calculated using the app, customers of Dillinger can immediately optimally adjust their welding system** (Picture: Dillinger)





## Sawing instead of groove turning

# Ring cutting machine evolves into machining centre

Dango & Dienenthal has developed a unique machine that separates huge sleeves into individual rings by sawing. Operation is faster and cheaper than grooving. The basic machine can be upgraded to a machining centre by attachments for turning, milling and drilling, and for ultrasonic testing.

**D**ango & Dienenthal has developed its new RTM 30-8 ring cutting machine in cooperation with the German mechanical engineering company Klaaßen Maschinenbau GmbH. Compared to the conventional method, the sawing of ring sleeves has a number of benefits. So far, the sleeves used to be cut into rings by grooving on carousel-type turning lathes. Due to the low cutting speed, the high tool wear and the necessity to repeatedly retract the chisel for the removal of chips, this was a rather time-consuming process. Additionally, the radial depth of cut – i.e. the maximum wall thickness of the sleeves – was limited to about 80 mm.

Now, Dango & Dienenthal und Klaaßen have developed a new machine concept based on experience with a prototype machine. Fundamentally new about the system is that the individual rings are no longer cut by groove turning but by a saw-

ing. The first full-scale machine is now in operation at Klaaßen.

## Sawing saves on material and enhances precision

Sawing instead of turning provides material savings between 30 and 50 percent – especially when producing thin rings. Thanks to the extremely precisely operat-

es, machining allowances can be drastically reduced.

Additionally, sawing reduces the cutting time dramatically – by up to 60% in case of steel rings and by up to 90% in case of high-strength materials such as titanium or nickel-based alloys. Also, non-productive times can be markedly reduced – by more than 40%, in case of six rings cut from a sleeve, for example.

**We enable our customers to manufacture rings on just one single machine, while in the past they usually needed three separate ones.**

*Boris Marcukaitis, sales engineer at Dango & Dienenthal*

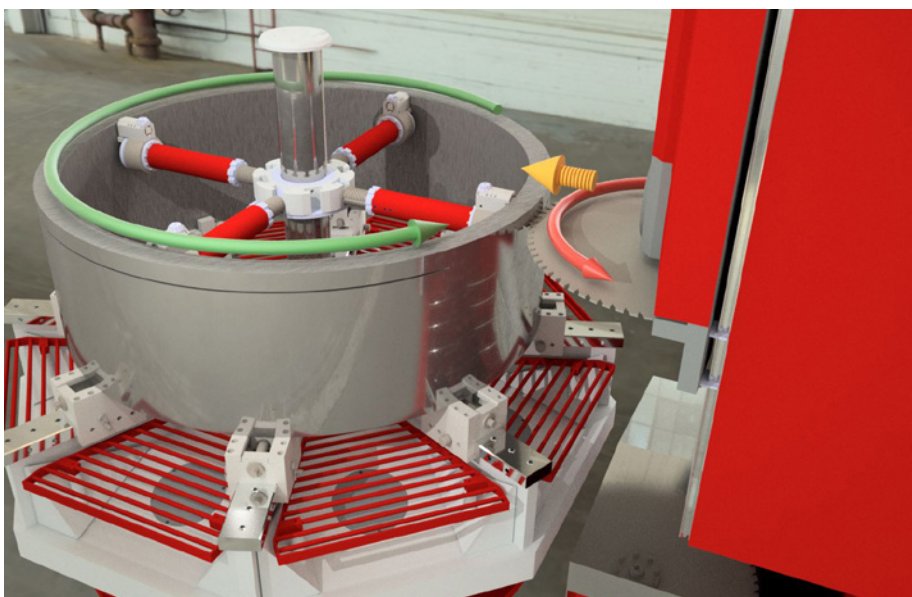
ing circular saw, the thin blade and the excellent plane-parallelism of the cut piec-

Further benefits of sawing over turning include: during sawing, the material in the kerf hardly increases in temperature, and a circular sawing blade – by nature – achieves a much better surface quality, resulting in a high plane-parallelism of the finished rings and practically totally dispensing with the need to rework the cut rings.

Moreover, the service life of a circular saw blade is much longer than that of a grooving tool. Sawing is also much safer than grooving because it does not produce one single large chip but many small chips, which are removed from the kerf by the circular saw blade.

## A cutting machine serving as a machining centre

Upgraded to a machining centre, the ring cutting machine provides a whole lot of additional benefits: Fitted with specific attachments – and without having to re-lamp the work piece – it performs many



**RTM 30-8 ring cutting machine: clamped on the turntable the sleeve is cut by a circular saw** (Picture: Dango & Dienenthal)

functions which used to be performed in separate steps on different machines. Thus non-productive times are significantly reduced.

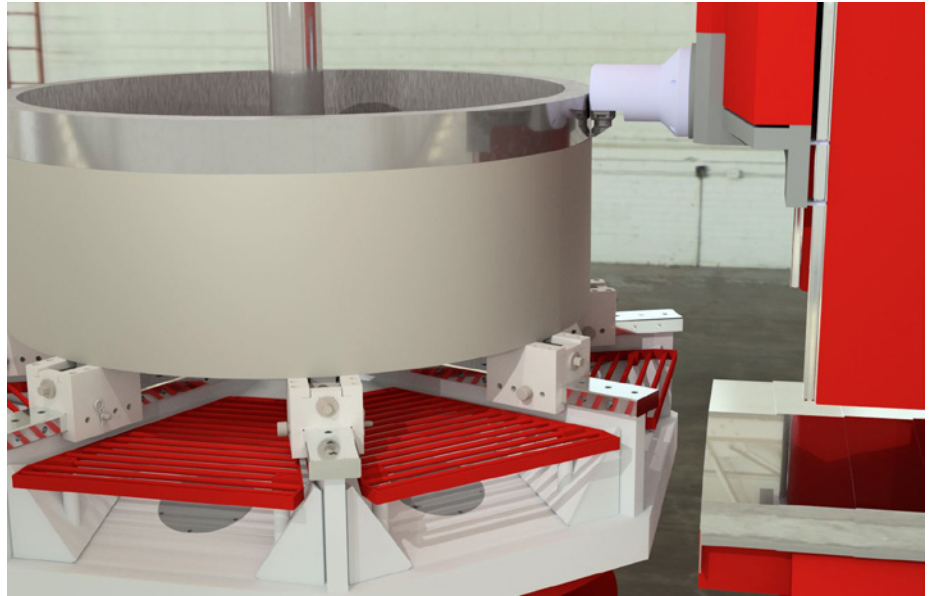
Besides a turning tool holder, the carriage-mounted tool unit can accommodate an ultrasonic testing probe, and drilling and milling heads. With these attachments the sleeve can firstly be finish-turned, followed by ultrasonic testing of the individual ring segments. This assures that whenever a portion of a sleeve does not meet the required specifications this will be identified at a very early stage and the corresponding material can be stopped from being further processed.

Boris Marcukaitis, sales engineer at Dango & Dienenthal, sees great benefits for his customers: "Sawing instead of turning alone provides tangible benefits in terms of material saving, quality and efficiency improvement, and cost reduction. On top of this, our new machine is able to perform further process steps without having to reclamp the workpiece. In this way, we enable our customers to manufacture rings on just one single machine, while in the past they usually needed three separate ones."

### The functional principle

The sleeve is firstly positioned on the turntable and clamped. At the top end – where the first ring is to be cut – the sleeve is fixed by means of height-adjustable clamping arms. Thanks to this arrangement, the height of the sawing kerf is held precisely constant throughout the cutting process.

Simultaneously, the outside of the sleeve can be finish-turned and inspected over its entire height. Then the first ring is sawed off. It will not drop back onto the sleeve rim because it is securely held in place by the clamping arms. From there the ring can be lifted up and removed by a crane with ease. Afterwards, the clamping arms will be lowered to the position of the next ring to be cut.



**Milling, drilling and testing can be executed in the same clamping position** (Picture: Dango & Dienenthal)

The use of a turntable provides the advantage that the rings can be cut while in a horizontal position. This makes the loading of the machine and the removal of the cut rings much safer. Even while performing the last cut, the ring remains securely fixed.

### Technical data

The clamping equipment can handle sleeves with diameters between 800 and more than 3,000 mm, and heights of up to 1,000 mm. It can accommodate sleeve weights of up to 20,000 kg and cut ring weights of up to 3,000 kg. By cutting with a sawing blade, a radial cutting depth of up to 550 mm can be achieved.

What is more, by sawing, rings with heights of only 15 to 20 mm can be produced. Such small ring heights cannot be produced by groove turning. By means of special clamping devices, such as "lost" jaws, it is even possible to cut rings of less than 4.5 mm height.

**Dango & Dienenthal Maschinenbau GmbH, Siegen, Germany**



**The prototype at Klaaßen Maschinenbau with that time exposed circular saw blade** (Picture: Dango & Dienenthal)





## Car body manufacturing

# Efficient sheet metal blank production with laser cutting systems

Schuler presented a die-free blank production and a new solution with two laser cutting heads. A universal laser beam performs the work formerly handled by conventional blanking presses. The laser beam makes it possible to alter the blanking shape at the push of a button, whereas altering a blanking die can take several months' time. While the growing amount of high-strength steels used in car bodies is increasingly pushing blanking presses closer and closer to their maximum mechanical loads, the laser blanking line easily processes high-strength steel.

Customers from Germany, the US, and China have already invested in laser blanking lines from Schuler. Recently, Schuler received another order by one of the largest Chinese steel producers for a plant in Tianjin—as well as an order from a customer in South Africa. On the occasion of the “Schuler Tech Days”, around 50 visitors took advantage of Schuler's invitation to learn about the benefits offered by the technology, where they also had a chance to look at the actual system that will be delivered to China.

A laser beam performs the work formerly handled by the dies. The universal cutting machine can flexibly change over to another blank shape at the push of a button, whereas altering a blanking die can take several months' time – not to mention the accompanying costs for storage and maintenance. And when the equipping time is factored in, the overall equipment effectiveness (OEE) climbs to 80 percent for the laser blanking line, compared to just 65 percent for conventional press blanking lines.

With the system's DynamicFlow Technology, a laser blanking line is up to 70 percent as productive as a modern servo blanking line with a press. “Output actually significantly exceeded our expectations,” says Martin Liebel, who manages the Schuler site in Heßdorf, a town located in the vicinity of Nuremberg. He adds that it is possible to regularly increase output by a few percentage points with the help of a number of smaller measures. A proven cleaning process ensures that the system produces high-quality



Rendering scheme of a complete laser blanking line (Picture: Schuler)

blanks which are also spotless—an important requirement for critical body shell parts.

In 2014, one high-end German automaker ordered its first two laser blanking lines for mass production, and the equipment began producing two years later. The same German carmaker went on to order two additional high-tech lines in 2017.

At roughly the same point in time, Schuler began development work on a new concept featuring two laser heads instead of three. “We needed a ‘bread-and-butter’ machine that would also deliver solid, acceptable performance for the rest of the world,” says Liebel. The decision proved to be the right one, as evidenced by the orders for two Laser Blanking Lines this year, from China and South Africa respectively. “The systems are becoming more and more dynamic, and the concept will win out in the end,” says a confident Liebel.

#### **Advanced distance control between laser head and coil**

One of the things that makes these systems so dynamic is the distance control for

the lasers. This control maintains a distance of 0.7 to 0.9 mm from the continuously moving coil and, where necessary, corrects the distance within fractions of a second to ensure that any residual surface irregularities in the sheet metal do not damage the heads. Liebel explains: “This axis is critical to the line’s output. Each coil contains residual waves. If I’m looking to blank at a rate of 100 meters per minute, I need to be able to respond extremely dynamically.”

tem, which adjusts the crowning on the straightener rollers.” Either the visualization system makes a recommendation based on the adjustment system, which the operator must then review, or the straightener itself can even provide fully automated control. “It’s important to remove as much of the tension from the material as possible so that the metal doesn’t pop up during blanking. These types of systems help to ensure process stability.”

**When it comes to yield strengths, there are no limits in laser blanking. We have performed many tests, and advanced high-strength steels are no problem.**

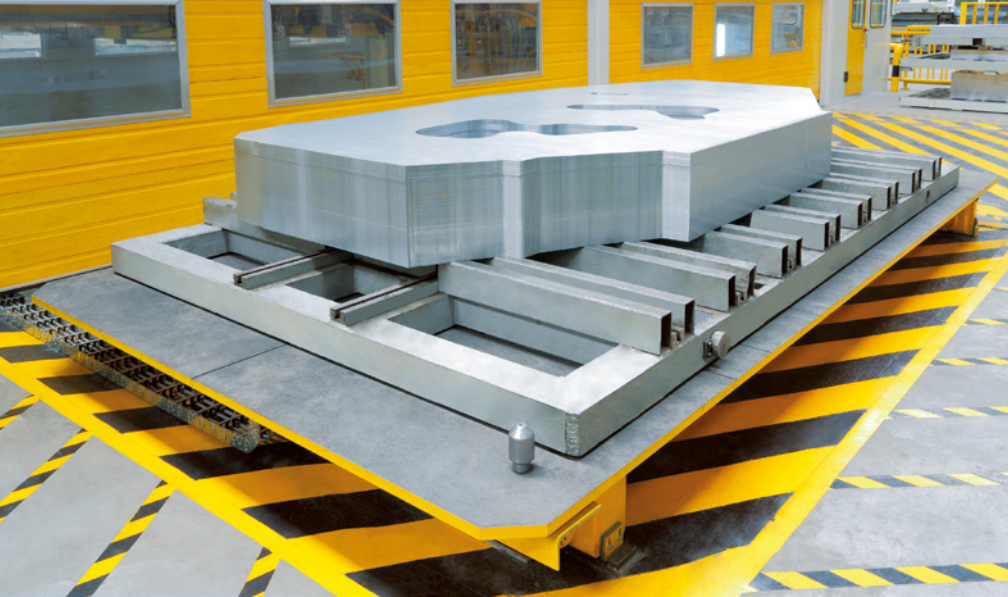
*Martin Liebel, site manager Schuler Heßdorf*

Larger surface irregularities are eliminated by the straightener. “The straightening result is a key ingredient to a stable process, especially for the laser blanking line,” adds Regional Sales Manager Justine Fonteyne. “To make this happen, we use the ‘Check2Flat’ sys-

#### **Adapting production capabilities across stamping plants**

According to Liebel, another increasingly important aspect for carmakers is the intelligent capacity utilization of production facilities spread across the globe. “But it’s diffi-





**Stack of laser cut blanks for car side panels** (Picture: Schuler)

cult to make a product somewhere else on short notice if you're using a press blanking line. To do so, they first have to move the dies, prepare for shipment, and then send them off." If a supplier is producing the blanks, the scrap chutes or something else may not fit. "With laser blanking lines in the production network, all I have to do is send a data set for the desired part and make sure that the coil material is available on-site. If on schedule, production can start one or two hours later. It's really a huge advantage."

Fonteyne's coworker Berthold Jüttner offers another example: "One of our customer's plant managers had a problem with a blanking press and had asked another plant manager if he would be able to cut a few blanks for him on the latter's laser blanking line. He then immediately sent the drawings and had the coils brought to the site. Blanking began the next day."

### **High surface quality and material utilization**

In addition to the newly achieved blank-programming freedom, Jüttner sees another advantage in the line's excellent dimensional accuracy, reproducibility, and surface quality: "There are no burrs, and the

amount of trumpery is much less than in conventional blanking." The so-called "angel's hair" phenomenon is especially prevalent where blanks are cut from aluminum coils, and is also the reason why blanking presses regularly need to stop to clean the dies. "This is no longer an issue with the laser blanking line."

Laser blanking also makes it possible to support the material across its entire surface area. "We can nest the parts edge-to-edge on the coil and no longer need the 8- to 10-mm dividers required when using the blanking dies. For small cutouts, we can briefly open the belts and the scrap can drop into the scrap chute." On the new lines, the scrap and good parts are no longer separated using robots, but rather by an intelligent sorting system. This provides an additional boost in output.

### **Laser handle easily also high-strength steel**

The growing amount of high-strength steels used in automobiles is increasingly pushing blanking presses closer and closer to their maximum mechanical loads, adds Liebel, who notes: "When it comes to yield strengths, there are no limits in laser

blanking. We have performed many tests, and high-strength steels are no problem." As Jüttner puts it, "The laser doesn't care at all what's under it."

According to Liebel, the bundled beam of light darts across the metal coil at speeds of up to 100 meters per minute at a thickness between 0.7 and 2.5 mm. He adds, "Before the year 2000, it was only possible to achieve blanking speeds of 4 or 5 meters per minute using CO<sub>2</sub> lasers. Then the fiber laser made its triumphant entrance and opened up the entire possibility of laser blanking for the first time. This development never would have been possible with conventional gas lasers."

What's more: Noise emissions are much lower than with blanking presses. "If sound protection is installed on the laser blanking line, you'll have to look very carefully to see whether the line is running or not," Jüttner says with a laugh. "You can have a completely normal conversation, as long as a press isn't running next to you." The investment cost is also significantly lower, since the laser line is not as tall and also does not require an elaborate press foundation, says Jüttner, adding: "That's a huge cost factor." The loop for material buffer is also routed above-ground. The laser line's energy requirements are comparable to those of a press blanking line, however.

### **Software makes blank programming easier**

Schuler has developed a software package "LBL Studio" designed to greatly reduce the operator workload required to program the laser cutting movement. "All you have to do is upload the drawing data, and the program will calculate the best-possible contours, the possible nesting options, and the optimum level of laser utilization," Fonteyne says as she lists the software's benefits. "This means that users can already define the laser movement contours and configure the transitions offline." The binding output quantities can also be predicted. "After that, the data can be transferred to the control system, and production can be run exactly as configured."

■ *Schuler AG, Göppingen, Germany*

**Entry section of the laser blanking line**  
(Picture: Schuler)



## Hunting Energy Services and Jindal SAW form strategic partnership

**Hunting Energy Services has signed a strategic alliance with Jindal SAW Ltd. in New Delhi.**

Under the partnership, Hunting Energy Services will share their patented Premium Connections technology with Jindal

SAW Ltd., who in turn will manufacture premium seamless casing and tubing using the connections technology. India's demand for seamless pipe with premium connections has until now been covered through imports. The partnership will now result in the manufac-

ture of finished seamless premium casing and tubing in India, and a reduction of imports.

**|** *Hunting PLC*

## Saudi Aramco places steel pipe order to expand oil and gas production capacity

**Liberty Steel Hartlepool, UK, has secured a major steel pipe contract for an offshore Saudi Arabian oil and gas development.**

This milestone contract covers the manufacture of more than 16 kilometres of heavy-duty steel pipe for an expansion of the Saudi Aramco Marjan field. Saudi

Aramco is the world's biggest oil and gas company by revenue. The company is planning to boost the Marjan and Berri fields' production capacity by 550,000 barrels per day of crude oil and 70.8 million standard cubic meters per day of gas.

Liberty, in conjunction with Sumitomo Corporation Middle East FZE, will supply

the Marjan project with submerged arc welded linepipe (SAWL) from its UOE mill, one of two mills it operates at Hartlepool. The offshore linepipe, suitable for highly-resilient 'sour service' application, is due for delivery by the end of 2019.

**|** *Liberty Steel*

## Mill Steel Framing strengthens commercial team

**Mill Steel Co., distributors of flat-rolled carbon steel, has added three senior sales experts to its commercial team.**

Kip Craddick, vice president of Mill Steel Framing, comes to Mill Steel with over 15 years of experience as a senior commercial representative in the metal framing sector. He will sit on the advisory board for the Steel Framing Industry Association.

Steve McDaniel, director of Mill Steel Framing, widely recognized as a metal framing commercial leader in the Mid-South, brings more than 25 years experience in the metal framing industry. The third person new on board is Brett Patton, senior account manager. He will focus on the expansion of Mill Steel Framing throughout the Southern United States.

These additions come on the heels of the recent announcement of the

rebrand of Mill Steel Framing. Previously known as Steel Structural Products, Mill Steel Framing, supplies a full line of metal framing materials, including ProStud and ProTrak, structural studs, and a variety of accessories, from all Processing and Distribution Centers located across the Midwest and Southern United States.

**|** *Mill Steel Co.*

## Placement of major pipe order for Baltic Pipe Project

**Salzgitter Group subsidiaries and associate companies will produce and supply around 30,000 t of steel pipes and 90 steel pipe bends for the Baltic Pipe Project.**

The Baltic Pipe Project is a European gas infrastructure project which will see Norwegian natural gas piped via Denmark to Poland. The EU is providing financial support for this project aimed at diversifying the European gas market.

The pipes will be manufactured by Mannesmann Grossrohr (approx. 24,000 t) and

Europipe (approx. 6,000 t), with the bends being produced by Salzgitter Mannesmann Grobblech. The input material including slabs for the production of sheet and hot rolled coils will be supplied by other Salzgitter Group subsidiaries and associate companies. Salzgitter Mannesmann International GmbH (SMID) will be responsible for the entire project coordination from preparation of offer through to execution of the order. The company will also safeguard the entire supply chain and collaborate with prominent financial service providers.

Between January and March 2020 Salzgitter Mannesmann International will ship pipes and bends to customer Energinet for Lot 2 of the project. Together with its road, rail and marine shipping partners, SMID will be responsible for the comprehensive project logistics including delivering and stacking pipes and bends at 24 different storage areas along the route of the pipeline.

**|** *Salzgitter AG*



New online portal goes live

## thyssenkrupp Materials Services sets milestone in B2B E-Commerce

thyssenkrupp Schulte, a subsidiary of the company's materials distribution segment, has launched a B2B portal throughout Germany. In a first step, the new digital offer is aimed at existing customers in the metal processing industry and trade. The B2B portal gives customers of Germany's biggest materials distributor 24/7 access to the company's complete standard range of around 17,000 products in 57 categories – quick and easy with one click of a mouse.

To better meet the needs of commercial customers, thyssenkrupp Materials Services is expanding its online business: In September, thyssenkrupp Schulte, a subsidiary of the materials distribution and service provider, has launched a B2B portal throughout Germany at portal. In the B2B web shop, detailed information on each product can be found – from the availability and price of the goods to material data sheets. Possible quantity discounts can also be identified at a glance. As soon as the customer selects a product and places it in the shopping cart, the expected delivery time is displayed. Standard materials are usually delivered within 24 to 48 hours. "Our new B2B portal is simple and intuitive to use, makes shopping convenient and thus makes our customers' day-to-day business easier," says Michael Bäuerlein, Head of Digitalization and E-Commerce at thyssenkrupp Schulte.

### Active on all channels

With the new B2B portal, Materials Services is taking the next important step towards implementing their omni channel concept. The materials expert is continuously expanding the order options for customers – for example, since the end of 2018 the "easy supply" app has made it possible to order materials via smartphone. Whether by app, phone, fax, e-mail or now at portal.thyssenkrupp-schulte.de – the aim is to meet customers' requirements across all channels with tailor-made offers and services. "We want to offer our customers individual access to our product portfolio and an optimal shopping experience – across all channels and independent of time and place," says Martin Stillger, CEO of thyssenkrupp Schulte.

thyssenkrupp plans to continuously expand the B2B web portal and comple-

ment it with additional convenience functions for all customer groups. In the future, for example, customers will be able to retrieve and manage various documents themselves – from delivery notes to certifications. In addition, new customers will also be able to access the platform in the long term.

### Digital transformation on the whole line

With the new B2B portal, thyssenkrupp Materials Services is systematically continuing its digitalization initiative – holistically and integrated. For example, in 2019 the materials distributor integrated artificial intelligence (AI) into its business processes: "alfred" is helping to dynamically manage the global logistics network with 271 warehouse locations and more than 150,000 products and services. The AI solution is also connected with the new B2B web portal and continuously analyzes the order items received in the online shop using this as a basis to determine the ideal transport and delivery routes to supply customers with the ordered goods in the best possible way.

### Open platform for digital transformation

tk Materials Services has consolidated its know-how in the area of production process digitalization (Industrial Internet of Things and Industry4.0) in thyssenkrupp Materials IoT GmbH, or tk MIoT for short, with the aim of supporting other companies in their transition to digitalized production. Materials Services is passing on its knowledge to customers, enabling them to benefit from the experience it has

One of the warehouses of tk Schulte  
(Picture: thyssenkrupp)



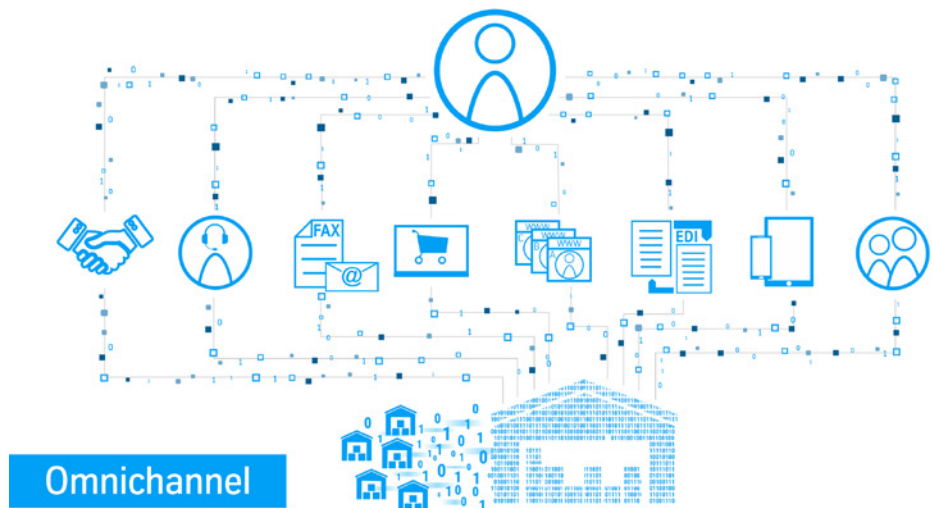
gained in the optimization and automation of production processes over the past 15 years.

One of the first core products is toi®. The IIoT platform developed in-house creates the conditions for machines of different makes and generations to communicate with each other around the world. The aim is to automate processes along the entire supply chain and make them more efficient.

"With toi® we have succeeded in bringing the digital transformation to the core area of our business: in the plant shops, machinery and warehouses," says Axel Berger, CEO of tkMIIoT. "We now want to help other companies take this step too." Materials Services has successfully implemented toi® at more than 30 sites since 2017. One plant has increased its annual production by almost 10,000 tons while other locations have reduced downtimes by up to ten percent.

### Digital transformation is essential

"The pace of innovation has picked up significantly in recent years and processes



The new B2B portal is a step towards implementing the omni channel concept (Picture: thyssenkrupp)

more important for companies to have competent partners they can rely on for innovative solutions to help secure competitive advantages and gain a foothold in Industry 4.0. We established tkMIIoT to respond to this need." The step is also an important component in the further strate-

provider in the western world is systematically expanding its service portfolio.

### Start-up meets tradition

tkMIIoT supports its customers throughout the transition to Industry 4.0: From advice on implementing IIoT technologies to support during the entire lifecycle of solutions and operation of the underlying platform. The company has an experienced team with extensive experience in industrial projects and combines a start-up culture with the traditions of a global group with more than 200 years of industrial experience.

## Our new B2B portal is simple and intuitive to use, makes shopping convenient and thus makes our customers' day-to-day business easier

*Michael Bäuerlein, Head of Digitalization and E-Commerce at thyssenkrupp Schulte*

are becoming increasingly digitalized and connected," says Axel Berger. "In this environment it is becoming more and

gic development of Materials Services: With its "Materials as a Service" approach, the largest materials distributor & service

**thyssenkrupp Materials Services GmbH, Essen, Germany**

## Walsin Yantai to build stainless steel bar and rod mill

### Lower cost production with in-line processing

To service increasing China market demand for high-quality stainless steel products, Walsin Yantai Stainless Steel Co. Ltd. has contracted with Primetals Technologies to design and manufacture a new stainless steel combination mill to convert billets from an existing plant into finished products with precision tolerance and surface quality. In-line-processing will lower

production costs. Start-up is expected in late 2020.

Located in Yantai, Shandong Province, China, the new mill project will be completed in a consortium with CERI Long Product Co. Ltd. The combination mill will have a straight bar outlet, a bar-in-coil outlet, and a wire rod outlet. The mill train will feature new-generation Red Ring stands, feeding a cooling bed equipped with abrasive saws, slow bin cooling and bundle-forming stations. The bar-in-coil

outlet will utilize the latest high-speed pouring reels with direct quenching. The rod outlet will include a Morgan no-twist mill, Morgan high speed shear, Morgan rod reducing/sizing mill and Morgan Stelmor conveyor, as well as an in-line direct solution treatment line for lower production costs, with vertical pallet coil handling.

**Primetals Technologies**



Healthy growth rate over the next five years

# Graphite electrode market for the metal industry to reach US\$ 15.3 billion in 2024

Stratview Research announces the launch of a new research report on Graphite Electrode Market for the Metal Industry 2019-2024. The report also addresses the current supply constraint (limited production capacity) of both graphite electrode as well as petroleum needle coke and its impact on the price as well as demand for graphite electrodes.



Graphite electrode is an essential component of steel production through the electric arc furnace (EAF) method. After five years of down-cycle, the demand for graphite electrode started emerging in 2016 with the increased production of steel through the EAF method. The penetration of EAF-based steel production is expected to be stable in the foreseen future, because of high awareness of the developed economies towards environmentally friendly technologies. The role of China and India in the production of EAF steel is going to be consequential in the coming years as the current penetration of EAF steel production in both countries are lower than the developed countries but will rise at a greater pace in the coming years. This will imprint a significant upward trend in the demand for graphite electrodes in the coming five years.

The market's supply chain is extremely dynamic with a tight supply of raw materials (petroleum needle coke) as well as graphite electrode coupled with the consistent increase in EAF steel production. The preference of lithium-ion battery in the increasing production of electric vehicles further takes the supply crunch to the next level. Petroleum needle coke is an essential raw material to produce lithium-ion battery. In addition, no substitute of graphite electrode in the production of EAF steel, makes the material a strategic resource rather than mere a commodity.

## Highlights from the report

As per Stratview Research, the market for graphite electrode in the global metal

**Graphite electrodes in operation at a ladle treatment facility** (Picture: SMS group)



industry is projected to grow at a healthy rate over the next five years to reach US\$ 15.3 billion in 2024. Steady increase in steel production through the EAF method, no substitute of graphite electrode in EAF steel production, and supply crunch owing to the limited production capacity of needle coke and graphite electrode are some of the factors propelling the demand for graphite electrodes in the metal industry.

Based on the **product type**, the market is segmented as ultra-high power (UHP), high power (HP), and regular power (RP). UHP is expected to remain the most dominant as well as the fastest-growing electrode type during the forecast period. Higher durability, higher thermal resistance, and superior quality are some of the properties that are propelling the demand for UHP graphite electrode, especially in the steel industry. All the major global players are primarily into the manufacturing of UHP graphite electrodes.

Based on the **application type**, steel manufacturing is currently dominating the graphite electrode market and is expected to maintain its dominance during the fore-

cast period. There has been a continuous increase in the production of EAF steel worldwide, which is the prime driver of the demand for graphite electrodes. For instance; in China, the share of steel production through EAF increased from 6% in 2016 to 9% in 2017 (still below the global average of 46%, excluding China). The government of China has set a target of achieving 20% steel production through EAF by 2020.

In terms of **region**, Asia-Pacific is expected to remain the largest market during the forecast period. China and India are the largest and second-largest steel producing countries through the EAF method, globally. Furthermore, among the leading players, five players (Showa Denko K.K. (Japan), Fangda Carbon New Material Co. Ltd. (China), Tokai Carbon Co. Ltd. (Japan), Graphite India Limited (India), and HEG Ltd. (India)) are based in Asia-Pacific.

The report also maps **supply chain** including raw material suppliers, petroleum needle coke manufacturers, graphite electrode manufacturers, and end-users. Showa Denko K.K., GRAFTech International,

Graphite India Limited (GIL), HEG Ltd., Tokai Carbon Co., Ltd., Energoprom, Fangda Carbon New Material Co. Ltd., Sangraf International, SEC Carbon, Limited, and Nippon Carbon are some of the major players in the market. Most of the major players have a capacity expansion plan in order to meet the growing demand for graphite electrodes in the coming five years.

*Stratview Research is a global market intelligence firm providing wide range of services including syndicated market reports, custom research and sourcing intelligence across industries, such as Advanced Materials, Aerospace & Defense, Automotive & Mass Transportation, Consumer Goods, Construction & Equipment, Electronics and Semiconductors, Energy & Utility, Healthcare & Life Sciences, and Oil & Gas. Stratview Research is a trusted brand globally, providing high quality research and strategic insights that help companies worldwide in effective decision making.*

■ Stratview Research, Detroit, MI/USA

## THERMPROCESS China trade fair will premiere 2020 in Shanghai

### Messe Düsseldorf expands its international "Metals and Flow Technology" portfolio

THERMPROCESS – the international trade fair for thermal process technology – is heading to China. As part of wire and Tube China from 23 to 26 September 2020 in Shanghai, Messe Düsseldorf Shanghai, together with its Chinese and international partners, will be organising a 500-square-metre pavilion dedicated to the full range of thermal processing technology. The Chinese market for this particular segment of metallurgy is booming. Imports to China from Germany alone reached a new 5-year high in 2019, and imports from the industrial nations Japan and Italy are also increasing. "We have developed the idea of placing individual brands from Bright Worlds of Metals on selected international markets and thereby adding an extra event to our Metals and Flow Technologies portfolio for some time now," Gerrit Nawracala, Deputy Director Global Portfolio Metals and Flow Technologies, explains the background to this strategic decision. "What is

more, with some 45,000 trade visitors and around 1,650 exhibitors, wire and Tube China is the ideal framework for this premiere."

The initial feedback from the industry is very positive. "There is a lot of interest in the Chinese market on the part of our THERMPROCESS exhibitors. Given that, talks with our customers are as promising as you would expect," reports Jennifer Dübelt, Senior Project Manager Messe Düsseldorf. The full range of thermal processing technologies will be presented in China: suppliers of industrial furnaces, industrial heating equipment as well as plant engineering, drive technologies, fuel technology, power and thermal engineering, heat treatment and technology, heating equipment, heat pumps and other accessories.

Further information are available at: <http://www.tubechina.net/en/exhibition/TPChina.html>

■ Messe Düsseldorf



Over 330 exhibitors from all over the world were showcasing their achievements at the 12th THERMPROCESS, trade fair and symposium for thermo process technology, in Düsseldorf in June 2019 (Picture: Messe Düsseldorf)





Vale S11D Eliezer Batista Complex in Brazil, aerial view of the mine (Picture: Ricardo Teles © Vale)

## Growing appeal of iron ore miners

# 5-year high iron ore prices look to revitalize mining sector

Mining companies across the industry are looking forward to a strong year as prices for various commodities continue to rise. Industrial metals in particular, such as iron ore, have broken records as prices surged to multi-year-highs. Iron ore miners are well positioned to take advantage of this change in the market.

Many different commodities have seen their prices jump so far in 2019. Precious metals, such as gold, silver, and for a time, palladium, have all seen prices surge in the first quarter. However, few could have guessed that industrial metals have seen some of the largest price spikes so far in the year, with iron ore reigning supreme in this regard.

After the tailings dam disaster in Brazil and cyclone-related disruptions in Australia, iron ore will be undersupplied in the near term causing prices to shoot up. This recent turn of events has made iron ore producers far more desirable in the eyes of analysts and investors. While major iron ore miners are expected to benefit from increased prices and the overall market enthusiasm, many less-well-known, small-

cap miners are poised to take advantage of this development as well.

Delrey Metals Corp holds a unique position in this regard, with their signature Four Corners Project based out of western Newfoundland. While other valuable metals like vanadium and titanium were found at the site, metallurgical samples of highly concentrated iron deposits in the area have peaked the ears of analysts and investors alike.

## The situation of the global iron market

Iron has surged by over 40 percent since late 2018, with prices having just recently broken the US\$100 per tonne price point hitting a high of US\$108. Passing a record

not seen in over five years, this rise is due to a variety of different factors.

One main reason contributing to this rise has been due to supply shortages out of Brazil. The world's largest iron ore producer, Vale SA, saw one of its biggest dams collapse in late January. With hundreds dead and billions of dollars of damages done to the environment, the Brazilian government stepped in to shut down many less-than-safe facilities. Since then, the company has said that these setbacks have taken out 93 million tonnes of iron ore out of the global market.

Other factors, such as poor weather in another major iron producing region, Western Australia, has also played a role in iron's surge in price. With demand for the industrial metal remaining strong amidst

these crucial supply shortages, investors have begun eyeing alternative iron-producing locations.

One of the most promising iron-producing regions in North America right now happens to be Newfoundland and Labrador. Already the largest producer of iron in Canada, the federal government has already recognized the untapped potential of the provinces iron reserves. Premier Dwight Ball has already stated that the government is planning to “double the current level” of output.

As such, the region has seen an influx of mining companies looking to tap into these untouched iron reserves. Labrador Iron Ore Royalty Corporation is one of the oldest iron miners in the province, having been around for over 81 years thanks to exclusive mining rights in Labrador West.

Other miners, such as Champion Iron Ltd, have recognized the region’s potential. Paying over US\$200 million to buy out a neighboring iron mine from the provincial government, miners are willing to pay significant sums in order to carve a piece out of Eastern Canada’s wealth of iron deposits.

Overall, iron prices show little signs of slowing down as experts around the world prepare for what has quickly become on

the most drastic iron shortages in recent history. Lourenco Goncalves, industry expert and CEO at Cleveland-Cliffs Inc, said that “What we are seeing in the world right now is the biggest pellet shortage that you could not have imagined what would happen.”

### Further mining developments

Champion Iron Ltd, made news in the mining world in May when it won the rising star company award. Given out at the 2019 S&P Global Platts Global Metals Awards, the company was singled out as a big mover in the Canadian mining industry.

With their iron output having already plummeted in recent months, Vale SA ended up issuing a warning about another potential dam break. Their Gongo Soco mine in Brazil was under threat of collapse, with local residents having already been evacuated. While Vale said the risk of an outbreak has diminished, analysts and investors are still worried about more potential collapses.

Cleveland-Cliffs Inc. announced earlier in the year that they were planning to issue C\$750 million in senior notes. The company intends to use these proceeds to pay

off some of their other bonds as well as other corporate expenses.

Posting their financial results for the first quarter of 2019, Labrador Iron Ore Royalty Corporation reported modest growth in comparison to the first quarter last year. Growing from C\$33.8 million to C\$38.5 million in first quarter revenues, investors and analysts were satisfied with these results as the stock price shot up.

Iron ore prices should continue to remain strong and this is being supported by the increased demand from the steel industry. Also, the ongoing trade war between China and the U.S. is expected to have a positive impact on the price of iron ore.

*Microsmallcap.com (MSC, Vancouver, BC, Canada) is the source of the article and content set forth above. References to any issuer other than the profiled issuer are intended solely to identify industry participants and do not constitute an endorsement of any issuer and do not constitute a comparison to the profiled issuer.*

■ Delrey Metals Corp.

## Ningbo Iron & Steel completes modernization of its hot strip mill cooling section

### Final Acceptance Certificate only 14 months after receipt of order

On 26 September 2019, only 14 months from the placement of the order, Ningbo Iron & Steel Co., Ltd., China, issued to SMS group the Final Acceptance Certificate for the successful execution of the laminar cooling modernization in its hot strip mill. The mill capacity is 4 million tons per year in the strip thickness range between 1.2 and 19 mm and strip widths between 900 and 1,630 mm. The rolled steel material are grades for household and building industry applications as well as grades for the automotive industry.

The main targets of the cooling train modernization were on the one hand improved cooling performance with tighter tolerances for the coiling temperature and on the other hand the extension of the product mix by dual phase steel grades DP 600 and DP 800 for automotive purposes,

pipe grades X60 and higher as well as non-grain oriented electrical steel.

The modernization package comprised six super-reinforced cooling banks at the entry of the cooling section and six reinforced cooling banks in front of the trimming zone. To avoid strip unflatness problems created in the cooling section, SMS

group installed the advanced header technology ensuring uniform flow over the complete width. Furthermore, a new cross spraying system with new headers has been installed operating with a pressure of 20 bar to allow highest cooling efficiency.

■ SMS group



View of the reinforced laminar cooling and cross spray systems (Picture: SMS group)



## Market research on the basis of thickness and end-use industry

# Global precision stainless steel market to expand 1.5x by the end of 2029

Future Market Insights provides critical insights on the precision stainless steel market, in its published report, which includes the global industry analysis 2014-2018 and opportunity assessment 2019-2029. In terms of market value, the global precision stainless steel market is projected to expand at a CAGR of over 4% during the forecast period, owing to various factors, regarding which, FMI offers thorough insights and forecasts in this report.

**P**recision stainless steel (below 0.4 mm) in the form of sheet or foil, is mostly used by food & beverage, automotive, pharmaceutical, aerospace, building & construction, and other industries (oil & gas, research & development, power, electronics, railway & transport, and others). In the report, precision stainless steel below 0.4 mm thickness is taken under consideration, where stainless steel foil (below 0.1 mm thickness), and precision stainless steel (0.1 mm to 0.4 mm) are categorized for in-depth analysis. Adoption of stainless steel foil is anticipated to increase in medical, aerospace, defence, petrochemical, laboratory, nuclear, and marine industries.

### Manufacturers entry uplifting market in China and ASEAN Region

In the global precision stainless steel market, East Asia is estimated to hold nearly half of the market share in terms of volume, owing to the rapid growth of the manufacturing and infrastructure sectors in emerging economies such as China and South Korea. In terms of production and consumption of precision stainless steel, China is attributed to be the leading country across the globe. In the East Asia precision stainless steel market, China is anticipated to be a highly attractive market in terms of market share and growth rate during the forecast period.

In the South Asia precision stainless steel market, India is attributed to provide lucrative market growth opportunities due

to the increased concentration of manufacturing and transportation segments. The entry of manufacturing giants in the ASEAN region is expected to deliver an impressive boost to the growth of the precision stainless steel market. In the ASEAN region, Indonesia is estimated to be the most significant market for precision stainless steel, while Malaysia is projected to expand at a high growth rate during the forecast period.

### Europe's market share gradually declining

The Europe precision stainless steel market is expected to witness slow growth owing to the maturity in demand from the manufacturing industry. By the end of 2029, the European precision stainless steel market is expected to lose market share to South Asia, as many manufacturing facilities are shifting to emerging economies in Asia. Germany is estimated to be the leading country in the European precision stainless steel market as it is the largest vehicle manufacturer in Europe. Energy and processing industries are actively driving the growth of the Russian precision stainless steel market during the forecast period.

Large infrastructure projects from GCC Countries promise exciting opportunities for the precision stainless steel market. The market is expected to witness impressive demand from Middle East & Africa, due to the increasing manufacturing and export of precision components for automotive from Turkey. In Latin America precision stainless steel market, Brazil is

expected to be a prominent country in terms of production, consumption, and export of precision steel products. Construction and infrastructure sectors are key contributors to the overall growth of the Latin American precision stainless steel market. The Oceania precision stainless steel market includes Australia and New Zealand, and accounts for less than 1% of the global precision stainless steel market share.

Key market players that have been profiled in the report on the precision stainless steel market include Nippon Steel Corporation, Jindal Stainless Group, ArcelorMittal SA, Aperam, Outokumpu Oyj, Kobe Steel, Ltd., Acerinox, AK Steel Corporation, Ulbrich Stainless Steels & Special Metals, Inc., and Baoshan Iron & Steel Co., Ltd., among others. Several unorganized and regional market players are expected to contribute to the development of the precision stainless steel market.

*Future Market Insights (FMI) is a leading market intelligence and consulting firm. The company delivers syndicated research reports, custom research reports and consulting services which are personalized in nature. Complete packaged solutions combine current market intelligence, statistical anecdotes, technology inputs, valuable growth insights and an aerial view of the competitive framework and future market trends.*

**| Future Market Insights**

## Conferences and symposia

<b>23th Middle East Iron and Steel Conference</b>	9 – 11 December 2019 Dubai, UAE	Fastmarkets <a href="https://t1p.de/5xol">https://t1p.de/5xol</a>
<b>Steelmaking and Casting – Sustainable Technology and Practices</b>	7 – 7 February 2020 Jamshedpur, India	Indian Institute of Metals & Tata Steel <a href="http://www.smcstp2020.com">www.smcstp2020.com</a>
<b>Aachener Stahlkolloquium – ASK 2020 „Steel and More“</b>	26 – 27 March 2020 Aachen, Germany	RWTH Aachen <a href="http://www.ASK2020.de">www.ASK2020.de</a>
<b>Eurocoke 2020</b>	27 – 29 April 2020 Amsterdam, NL	Smithers <a href="http://www.metcockemarkets.com">www.metcockemarkets.com</a>
<b>AISTech 2020 Conference</b>	4 – 7 May 2020 Cleveland, OH/USA	Association for Iron & Steel Technology <a href="http://www.aistech.org">www.aistech.org</a>
<b>SCT 2020 – Steels in Cars and Trucks</b>	14 – 18 June 2020 Milan, Italy	TEMA Technologie Marketing AG <a href="http://www.sct-2020.com">www.sct-2020.com</a>

## Exhibitions, trade fairs

<b>Tube &amp; wire 2020</b>	30 March – 3 April 2020 Düsseldorf, Germany	Messe Düsseldorf <a href="http://www.tube.de">www.tube.de</a> – <a href="http://www.wire.de">www.wire.de</a>
<b>AISTech 2020 Exhibition</b>	4 – 7 May 2020 Cleveland, OH/USA	Association for Iron & Steel Technology <a href="http://www.aistech.org">www.aistech.org</a>
<b>Metal + Metallurgy China</b>	13 – 16 May 2020 Shanghai, China	CIEC Exhibition Co., Ltd., CIEC Group Corp. <a href="http://www.mm-china.com">www.mm-china.com</a>
<b>Metallurgy – Litmash Russia</b>	9 – 11 June 2020 Moscow, Russia	Messe Düsseldorf <a href="http://www.metallurgy-russia.com">www.metallurgy-russia.com</a>

## Seminars

<b>Electrical engineering of arc furnaces</b>	9 – 11 March 2020, Cologne, Germany	Steel Academy of Steel Institute VDEh <a href="http://www.stahl-akademie.de">www.stahl-akademie.de</a>
<b>Cokemaking</b>	20 – 23 April 2020, Duisburg, Germany	Steel Academy of Steel Institute VDEh <a href="http://www.stahl-akademie.de">www.stahl-akademie.de</a>
<b>Refractory technology</b>	26 – 29 April 2020, Cologne, Germany	Steel Academy of Steel Institute VDEh <a href="http://www.stahl-akademie.de">www.stahl-akademie.de</a>
<b>Hydrogen-based reduction of iron ore</b>	4 – 5 May 2020, Cologne, Germany	Steel Academy of Steel Institute VDEh <a href="http://www.stahl-akademie.de">www.stahl-akademie.de</a>



## Preview of the Februar 2020 issue

### Steelmaking

#### Sustainable EAF operation in terms of material and energy

Approximately 28-30% of the global crude steel output is made through the Electric Arc Furnace (EAF) route. EAF operations are very flexible in terms of raw material used and steel grades produced. In order to be competitive a good material efficiency (metallic yield, but also process material consumptions like

electrodes or refractories) and energy efficiency (electrical and chemical energy) are essential. Moreover, this needs to be achieved, while minimizing the environmental footprint and understanding the impact of various raw material sources and/or energy sources on productivity and steel production costs.

### Strip processing

#### Pickle line prepared for advanced high strength steels

While common technologies are unable to successfully cope with the requirements of advanced steel grades, Umlauf Bridles build up strip tension high enough to ensure that also thick-gage

and high-strength strip will leave the pickle line in a perfectly levelled condition. A modernized pickle line in the US is the first in the world to use exclusively Umlauf Bridles for the strip transport.

#### Wiping systems for hot dip galvanizing lines

Danieli Kohler provides wiping systems around the world to produce high-quality coated products. The ability to supply high-technology, customized solutions is the key to its success, with 200 installations in molten metal-coating lines of all types. This experience allows Danieli Kohler to push the technology to new heights in terms of performance, pro-

ductivity, zinc-saving and surface-quality improvement. Further development resulted in the Compact X-JET (CXJ) air knife, designed to be even more easily integrated in existing galvanizing lines. The critical dimension perpendicular to the strip is significantly reduced for the Compact X-JET (CXJ). It is now possible to fit into extremely crowded pot areas.

Ad closing for the next issue: **24 January 2020**  
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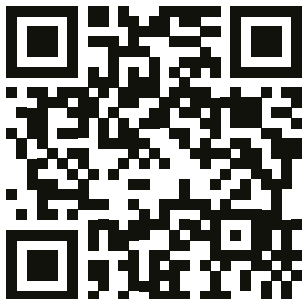
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