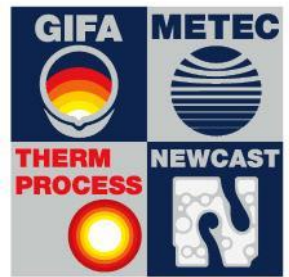


Press Release – Expert Article No. 4

Steelworks live and breathe digital transformation

From ArcelorMittal to Thyssenkrupp: digitalisation has arrived in the steel industry – driven by the wish to improve the margins of existing business and increasingly by the challenges of decarbonisation. It is first and foremost improved earnings and extension of the service portfolio rather than disruptive new business models that feature on the agenda of steel mills. New digitalisation solutions – from the transformation of the blast furnace to the vision of an autonomous steel mill, from digital melting operations to foundry 4.0 – will be a focal theme at the coming metallurgy trade fairs GIFA, METEC, THERMPROCESS and NEWCAST held in Düsseldorf from 12 to 16 June 2023.

In the highly automated steel industry data have long played a pivotal role. Take ThyssenKrupp Steel, for example: the hot strip mill in Duisburg alone not only processes about 16,500 tons of steel slabs but also the data of more than 1.2 billion measurements. Terms like Big Data, Digital Twin and Machine Learning are today just as familiar to metallurgists as tapping and slab casting. Artificial intelligence (AI) specialists and App programmers join traditional workers such as blast-furnace and hot rolling mill operators. Digital twins map production from start to finish and can be used for all steps in the value chain of products, plants and services alongside the real steel mill. One key objective is to analyse product and machine data across various process steps. With the help of Data Analytics such material characteristics as thickness fluctuations, roughness or stiffness can be forecast precisely and tolerances can be adhered to more closely. To this end, thousands and thousands of sensors capture the quality and production data across the entire flat steel process chain. This data base forms the basis for controlling and analysing manufacturing processes in real time. In ThyssenKrupp Steel's No. 8 hot-dip coating line in Dortmund the data analytics results are used to generate mathematical models for controlling the skin pass mill. The data model controls the line in such a way that the aspired roughness values of the steel strips are reached and the operation mode can be re-adjusted online if needed. This opens up new service options for steel producers. Commenting on this Lothar Patberg,



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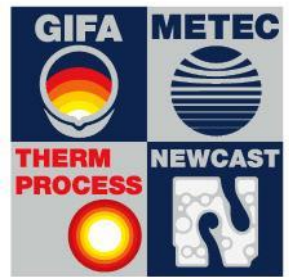


Head of Innovation at Thyssenkrupp Steel said: “In future, customers would be able to not only track the current status of their orders. They could also obtain selected quality data from manufacturing with a view to adjusting their own processes before the coil is delivered.”

The technological switch to CO₂-free production with hydrogen and renewable energies has provided added momentum to the uses of digital technologies. According to consultancy Accenture, in industrial manufacturing up to 61 megatons of CO₂ could be saved by 2030 through digitalisation. Metallurgy plant builders such as SMS, Primetals and Danieli have long identified this potential: to strengthen their own enterprise but above all to open up new lines of business.

SMS digital: the big ones develop the market

A pioneer in digitalisation exhibiting at METEC 2023 is the Düsseldorf-based SMS group. Automation technology has formed part of this metallurgy plant builder’s DNA for many years. Technologies such as Virtual Reality (VR), Augmented Reality (AR) and Digital Twins were used by their engineers in steel mill development long before Industry 4.0 hit the headlines. While in the past individual divisions like the rolling mill were automated, digitalisation today connects the entire production line from the blast furnace to the finished product on all levels. SMS was among the first in this industry to identify the potential digitalisation holds for developing new business lines and established the start-up SMS digital in 2017. What started with 10 members of staff in a backyard, is now the leading software provider for metallurgy: SMS Digital GmbH with more than 350 specialists employed worldwide. As Chief Digital Officer on the board of SMS group Katja Windt, a former university professor with a PhD in engineering, has been responsible for the key areas of digital transformation – at her own company and with customers. The SMS digitalisation boss views the 150 years of process know-how in the metallurgical sector as a key advantage over competitors, or potential new entrants such as the digital champions Google or Amazon that have long had their sights on the industry. Digitalisation for process optimisation and energy management also forms an essential part of the new business lines of the SMS group. As a global player for the reduction of carbon dioxide emissions and the circular



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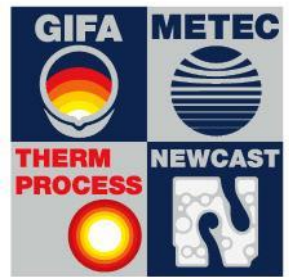


economy the plant builder has successfully invested in decarbonisation and recycling technologies – ranging from climate-neutral steel production based on hydrogen, battery recycling and urban-mining solutions for reclaiming precious metals from electrical scrap to plants for producing green syn-gas and synthetic fuels.

Big River Steel: learning steel mills are just the beginning

Digitalisation focuses on the steel industry. As early as METEC 2019, the International Metallurgical Trade Fair with Congresses, the plant builder was able to present the world's first "learning steel mill" together with Big River Steel. The mill built by SMS in the USA and digitalised and fitted with artificial intelligence (AI) in cooperation with partner Noodle.ai is run to be as resource and energy-saving as possible today. The AI by Noodle.ai analyses historical data and in part high-frequency signal series captured by more than 50,000 sensors. In addition to the steel mill's data the AI platform also uses external data sources that capture and predict manufacturing processes, and even propose corrective measures. This means artificial intelligence helps to maximise the yield, improve product quality and eliminate safety risks. Huge data volumes from which AI generates knowledge allowing BRS to produce high-quality steel products at a lower cost and faster. The learning steel mill in the USA is just the beginning. For digital boss Windt the objective is self-controlling production: a steel or aluminium mill that runs autonomously with the help of learning algorithms. The key product for digitalisation in SMS' modular digital kit is the so-called Data Factory that collects and edits sensor data. Depending on custom requirements and desired performance increase, a wide variety of applications can be hooked up to this software platform. In conventional manufacturing finished products are checked for defects. Defective goods trigger a search for root causes and the cause must be eliminated. Following Industry 4.0 Logic, defects are prevented before they occur through constant monitoring. This saves time and money.

Customers do not necessarily have to buy new equipment to get the performance. As a new business model SMS also offers "Equipment-as-a-Service". "Customers conclude a service contract with us for a component,



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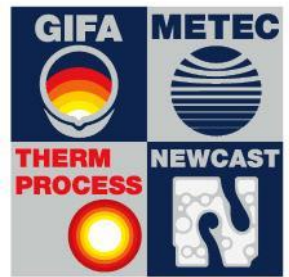
such as part of a rolling mill or a continuous casting line,” explains Windt. So the plant builder does not sell the equipment but the customer pays for its operation and the digital applications used.

The power of digitalisation has become evident during the Covid pandemic if not before. With the help of its AR SMS was able to commission steel mills remotely, i.e. without service engineers being on site as was the case before.

Smart Steel Technologies: start-up ready to attack

Smart Steel Technologies (SST) promises to reduce energy consumption and the emission of climate gases such as carbon dioxide in steel production by means of artificial intelligence (AI) and machine learning (ML). Established in 2017 by mathematician Dr. Falk-Florian Henrich in Berlin, this start-up has set out to optimise processes on all levels. To this end the steel industry is set to change from control-based production to AI-based manufacturing.

Steel producers transform conventional manufacturing processes towards higher energy savings and CO₂ reductions. With a gradual changeover from coal to hydrogen as a reducing agent, carbon dioxide emissions are already reduced at the blast furnace. Add to this new process pathways such as direct reduction using natural gas initially and later hydrogen as part of the decarbonisation route for steel production. This is why steel producers need solutions to assess and control the CO₂-efficiency of all production routes as well as their carbon and energy footprints broken down for each individual steel product. The pressure to do so emanates not least from customers. In the automotive industry the carbon footprint is increasingly becoming a sourcing criterion for steel products. “Precise energy and CO₂ data allow steel producers to charge for their conversion efforts and complete audits successfully. Automated CO₂ and energy analyses with AI-based models are the key to this,” says Henrich. With SST’s AI-based software packages, he explains, it is possible to precisely document and trace back the energy consumption and CO₂ emission for every flat or strip



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product. AI considers numerous factors impacting energy efficiency such as raw material quality, product mix and maintenance.

SST boss Henrich succeeded in convincing not only companies as Feralpi and Vallourec with the strength of his AI solutions but also the world's biggest steel producer ArcelorMittal. For instance in Eisenhüttenstadt: here AI and ML methods managed to improve the surface quality of high-end steel grades for the automotive industry by more than 50%. The AI software is not only used to forecast the surface quality but also to prevent surface defects from forming. After the successful trial run in Eisenhüttenstadt ArcelorMittal has also installed software from the SST family at sites in Bremen, Hamburg and Duisburg.

Fero Labs: change of raw material composition in real time

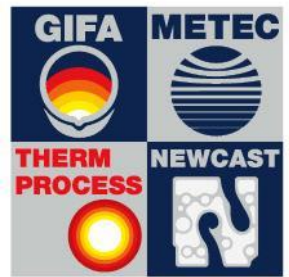
US start-up Fero Labs also seeks to score points with decarbonisation and green steel, as Head of Business Unit Europe Tim Eschert confirms. The AI software by Fero Labs makes it possible, he explains, to change the raw material batch composition in real time and, hence, to significantly reduce the probability of rejects in the manufacturing process: "At the Brazilian steel producers Gerdau with a medium production volume we achieve some 9% savings a year."

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