Reducing CO_2 emissions with the aid of machine learning: digital solutions to enable climate neutral steel production

Whether in politics, civil society or business, there is agreement that industry must become greener, yet the steel industry in particular is faced with a mammoth task. The share of global CO_2 emissions attributed to the steel and aluminum industry stands at around 7%. Every year, 4.4 billion tons of CO_2 are emitted by steel producing companies. SMS group believes it has a responsibility to bring about the transformation to green steel production. At the same time, businesses want to improve production efficiency, make optimal use of their plant's capacity, increase their product quality, reduce emissions and save energy in the process.

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Companies in the steel industry have long recognized the need to change their production to become 'green' and are increasingly deciding to digitalize their plant processes and use new technical processes, such as hydrogen. The switch to CO_2-neutral production therefore requires a willingness to invest in new technologies. Accordingly, digital transformation is not merely a technical challenge, but rather involves transforming a company to achieve maximum efficiency and to optimize its operational potential. SMS group not only offers companies the hardware and software for this but also supports them with an integrated service and consulting services to identify the potential for improvement and to achieve a quantifiable and fast return on investment.

For a comprehensive digitalization strategy, complex processes have to mesh with one another effectively. Various disciplines, such as mechanical engineering, logistics, and services must communicate efficiently with each other to break away from the classic silo mentality (*Figure 1*). The intelligent linking of processes with digital applications enables the performance of a plant complex to be designed from the ground up to be efficient, resource-saving and sustainable. SMS develops software that helps companies to better automate their metal production, a kind of autopilot for the production processes, and at the same time makes an important contribution towards reducing energy and resources along the entire production chain. This enables reliable prediction of plant condition and product quality, optimal production planning and efficient energy management.

Companies must be able to process and analyze large volumes of data to identify meaningful relationships. ▷

Fig 1 Linking a variety of assets enables holistic, autonomous plant operation.

Fig 2 **The SMS DataFactory: a central hub for exchanging data between predictive production systems**

Fig 3 **The Viridis Energy & Sustainability Suite**

High end technology and applications based on machine learning help unlock the full potential of plants and processes and achieve full plant connectivity and utilization. Supercomputers in the cloud provide the computing power required to meet more complex challenges such as the holistic optimization of production. Smart technologies will permanently change the industry and enable plant operators to retrieve all data for a plant from anywhere, at any time.

APPLICATIONS FOR INCREASED PRODUCT QUALITY

The learning steel plant optimizes itself by learning from experience and autonomously adapting production processes, so that plants operate efficiently and sustainably at maximum capacity. Predictions of plant availability and process stability form the basis for all subsequent processes, for example, the autonomous release of products of the highest possible quality. The Quality Execution System (QES) monitors, records and ensures product and process quality along the whole production chain, from raw material to surface-finished final product. It uses the information it receives from upstream applications and adapts all parameters, to achieve the highest possible product quality. For this purpose, the SMS DataFactory acts as a data hub that collects and evaluates plant data and forwards it to the corresponding systems (*Figure 2*). It enables the full preparation and analysis of all plant data.

Predictive systems ensure control of the plant by means of intelligent strategies, such as parameter settings that avoid production errors. Holistic and self-planning sequencing also continuously optimizes the sequence of orders based on the plant's condition and production requirements. Software products can predict when a certain plant component will fail, by performing an intelligent analysis of patterns from parameter combinations. In this way, the maintenance cycle can be adapted entirely independently. This also means that the feedstock can be precisely calculated. As a result, downtimes are significantly reduced, which in turn saves valuable resources and energy.

EFFICIENT ENERGY MANAGEMENT

To optimize the energy balance over the whole production process, reduce CO_2 emissions, and minimize the use of resources, energy optimization tools such as the Viridis Energy & Sustainability Suite are employed (*Figure 3*). Viridis offers a comprehensive management solution for steel plant operation and optimizes not only throughput and quality, but also costs related to energy, the use of raw materials, and even carbon, greenhouse gas and waste emissions. This is where energy performance indicators as well as AI and machine learning algorithms are utilized. In turn, these indicators pass information to production planning and quality management software, so that the system can take into account the relevant parameters during ongoing and future production processes, and plan production in a way that is as efficient and environmentally friendly as possible.

ENTERING THE WORLD OF DIGITALIZATION

No plant needs to be digitally ready straight away. It is enough to take small steps at the beginning. SMS offers various contract models that are tailored to the needs of customers. Performance based models are also available, for instance splitting the cost saving benefit between the customer and supplier. This helps minimize the risk for the customer, as well as potential R&D costs.

Digitalization offers enormous opportunities for financial optimization. Every company collects some data that is then not used to add value. By utilizing digital applications, SMS converts data into information, and then employs advanced analytics, among other tools, to turn this information into value. Digitalization is becoming more and more sophisticated in the process. Smart Data is derived from Big Data. Through digitalization, companies have the potential to respond flexibly to changes in their production processes by implementing digital solutions that allow resources to be used in the best possible way.

CROSS-INDUSTRY DIGITALIZATION TECHNOLOGIES

Digital technologies from SMS are not only used in the steel industry but also in other sectors, such as aluminum and copper processing. SMS solutions and methods are so universal that they can also be used in other industries, like paper or glass production. The intelligent alarm management system alarm manager, for example, can be used for plant management in a variety of different industries.

Fig 4 **Virtual representation of a machine using a digital twin**

SMS group's digital solutions are also used in logistics. The SMS subsidiary AMOVA, for example, has launched a revolutionary high-bay container storage and handling system in the BOXBAY joint venture.

THE STEEL PLANT OF THE FUTURE

The learning steel plant is no longer a distant dream, but is already being implemented. It optimizes itself by learning from experience and by autonomously adapting production processes so that plants operate efficiently and sustainably at maximum capacity. Using digital twins, the properties and behavior of real objects under certain conditions via sensors can be connected to the real world in real time and test these before using actual material (*Figure 4*). Digital solutions based on machine learning enable plant owners to increase their productivity and quality, save resources, and minimize downtime. Using augmented and virtual reality, for example, it is already possible to commission a customer's plant completely remotely, without being there in person.

It is the interaction of various disciplines and intelligent software that enables sustainable and efficient production. This is the only way in which steel production, backed up by digitalization, can become green. MS

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