

Cooperation for low-carbon steel production: thyssenkrupp Steel is working with international partners on carbon-neutral steel production with a focus on smelter technologies

- thyssenkrupp Steel and BlueScope Steel are scaling up their research activities for carbon-neutral steel production with a focus on smelting units and direct reduction plants
- Two electrically operated smelters to process 2.5 million metric tons of directly reduced iron into hot metal annually
- Technology offers numerous advantages in an integrated metallurgical network
- The "SAVE CO₂" research project aims to make smelter slag usable for the cement industry

Duisburg, August 2024 – thyssenkrupp is scaling up its research activities in the field of low-carbon steel production to include a cooperation with BlueScope Steel. The focus of this cooperation is on the smelting units, which form a core component of the first step in the transformation towards carbon-neutral steel production, namely the replacement of the first blast furnace by a direct reduction (DR) plant with downstream smelters.

In the smelters, directly reduced iron (DRI) and aggregates are melted to form hot metal. Two identical smelters, each electrically operated and with a capacity of 100 MW, are being built to process the annual volume of 2.5 million metric tons of DRI. The DRI will be transported directly from the DR plant to the smelters via hot conveyor systems. The melting processes run continuously with the help of multiple high-performance electrodes and, ideally, renewable electricity in closed furnace chambers. Both the closed system and continuous operation differentiate the smelter technology from conventional electric arc furnaces. Temperatures of up to 1,700°C are reached in the process, so the smelters are lined with refractory material. The hot metal and the resulting slag are discharged into the respective cast houses via separate tapholes. The hot metal is then filled into torpedo ladles via a channel system and transported to the steel mills for further processing. The molten slag is directed to the slag granulation plant to produce granulated blast-furnace slag, which is used as a substitute for clinker in the cement industry.

The smelters offer numerous advantages in an integrated metallurgical network: they enable the production of equivalent "electric furnace iron" while all other process stages, including the steel mill, remain in place and investments in plants and equipment are minimized. By

retaining all process steps from the steel-mill stage onward, thyssenkrupp Steel continues to provide its customers with the entire range of steel grades in the usual high quality. Moreover, the use of a smelter offers a flexible raw material basis, since DR pellets with a higher proportion of gangue and lump ore can also be used in the DR plant, besides which the exhaust gases from the smelters can also be materially or thermally recycled.

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One of the purposes behind the research cooperation with BlueScope Steel, which is planned to run for four years, lies in achieving an enhanced understanding of the processes and optimizing plant management in the run-up to the commissioning of the smelter. This encompasses the topics of electrode management, furnace driving mode, process parameters, refractory material and maintenance. BlueScope Steel contributes a wealth of valuable experience gained from operating smelters in New Zealand using DRI made from iron sand.

The transformation to carbon-neutral steel production also has an impact on by-products. Already launched in 2021, the "SAVE CO₂" research project is aimed at conditioning the smelter slag in such a way that it can be used from the blast furnace slags, as has been the case to date with the granulated blast furnace slag. In this way, the slags resulting from a CO₂-free iron ore reduction process can also continue to be used as substitute materials in the cement industry, and thus contribute to recycling management. In decarbonized steel production, too, the positive technological, economic and ecological properties of the resulting slags are retained.

This comprehensive strategy enables carbon-neutral and sustainable steel production, enhanced through intensive research and collaboration with international partners such as BlueScope Steel. The advantages of integrated production, such as the complete recycling of all materials generated in the process and the efficient use of product cycles, are thus preserved. This not only ensures environmental sustainability, but also helps boost the profitability and competitiveness of the steel industry.

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