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Circular Carbon and Electrified Heat: Carbon neutral Syngas heated by Paul Wurth Tempra to reduce Blast Furnace CO_2 Emissions

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Decarbonizing existing Blast Furnaces is a critical challenge for integrated steel plants aiming for climate neutrality. This paper introduces a technological pathway that uses thermal dry reforming of coke plant by-products and Paul Wurth Tempra for electric gas heating in a top gas recycling Blast Furnace scheme.
SMS group has developed the OXYTAR technology, which converts the hydrocarbons contained in the coke oven gas (COG) and coke oven plant by-products (tar, coke fines) into high-quality reducing gas through thermal dry reforming at temperatures up to 1400℃. Pilot campaigns at an industrial coke oven plant validated the technology at TRL6, achieving syngas compositions suitable for effective use in the Blast Furnace process. The direct injection in the Blast Furnace Shaft of this syngas once mixed with other available steelmaking gases, transforms waste streams into valuable feedstock, supporting circularity and lowering Scope 1 CO_2 emissions from Blast Furnaces in retrofit configurations.
To maximize efficiency and eliminate fossil fuel combustion in hot stoves, SMS group has developed the Paul Wurth Tempra system for electric heating of syngas to temperatures exceeding 1100℃. This electrification step, which can be powered by renewable electricity, ensures precise thermal control, high energy efficiency (>97%), and compatibility with hydrogen-rich blends when integrated with Top Gas Recycling Blast Furnace (TGR) with CO_2 removal.
These combined technologies enable an opex friendly staged decarbonization: starting with a 30% CO_2 emission reduction by utilizing internal available streams in integrated steel plants and reaching up to 70% with the incorporation of hydrogen in the top gas recycling loop, according to ISO 14404 CO_2 emission calculation standards.
Tempra system, combined with existing hot stoves, offers a unique solution for leveraging the variable cost of renewable electricity throughout the day in a Thermal Energy Storage configuration. This minimizes the cost of electrical power, which is typically a concern in areas where existing blast furnaces operate.
The proposed solution provides a scalable and staged retrofit strategy for existing blast furnaces, minimizing CAPEX while aligning with emerging green steel standards. Beyond CO_2 emission reduction, the concept enhances energy efficiency, valorizes by-products, and offers a flexible platform for future integration with hydrogen and carbon capture/utilization (CCU).
This paper will detail the process fundamentals, energy balances, and implementation scenarios, demonstrating how OXYTAR and Tempra can accelerate the transition toward low-carbon ironmaking without compromising productivity and providing the best OPEX and CAPEX when natural gas is not available.

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