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CDRI preheating system by off-gas heat recovery for charging into EAF

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Electric Arc Furnace (EAF) steelmaking is a highly energy-intensive process, with substantial heat losses occurring through off-gas emissions. flue gas emissions. The process designed based on our research proposes an advanced waste heat recovery system to enhance energy efficiency by preheating Direct Reduced Iron (DRI) before its charging into the EAF. The system utilizes a high-efficiency heat exchanger to transfer thermal energy from the hot off-gas to a closed-loop nitrogen stream, which then circulates through a specially designed preheating chamber above EAF containing the incoming DRI. This indirect heat exchange mechanism ensures effective thermal energy transfer while preventing oxidation or contamination of the material. After delivering heat to the DRI, the nitrogen undergoes mist eliminator before being recirculated.
By integrating this heat recovery system, significant reductions in electrical energy consumption and tap to tap time can be achieved, and of course, on the one hand, the production capacity is significantly increased, and on the other hand, the consumption rate of refractory and electrode is reduced; as well as improving furnace thermal efficiency and overall process sustainability.
The approach not only optimizes energy utilization but also enhances productivity by pre-heated DRI and improving its reaction kinetics during melting. A comprehensive simulation-based evaluation, including thermodynamic analysis and economic feasibility assessments, has been conducted to quantify energy savings and cost-effectiveness. The results demonstrate a considerable reduction in energy demand, lower CO_2 emissions, and improved process stability, aligning with the industry's transition toward more sustainable and resource-efficient steel production. This study highlights the potential of heat integration strategies in EAF steelmaking and provides a scalable framework for future advancements in waste energy utilization.

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