High efficiency combustion system for Non-Oxidizing Furnaces for steel processing lines

Cockerill Maintenance & Ingénierie
Background

The European steel industry employs 360,000 skilled people producing almost 170 MT of steel within the 27 EU Member States (High-level roundtable on the future of the European Steel Industry, 2013, EC). This industry is a high energy consumer and on average, 1.8 T of CO₂ is emitted per ton of steel produced. The steel industry combined with the iron industry account for almost 7% of the world’s total CO₂ emissions (Steel’s contribution to a low carbon future, 2013, worldsteel.org). From 2006 onwards, a significant part of steel furnaces in Europe integrated energy savings and lower emissions as parameters in economic evaluations, requiring the implementation of Best Available Technologies (BAT) for combustion and energy recovery due to the need of competitiveness and resource efficiency in furnace technology:

• Minimizing the environmental impact of existing furnaces.
• Reducing operational costs, mainly energy consumption and maintenance costs.

Currently, waste gases from Continuous Galvanizing Lines (CGL) and Continuous Annealing Lines (CAL) are conveyed to the stack going through a centralized recuperator. This recuperator preheats combustion air to temperatures near 450°C, feeding the direct-fired furnace burners for the combustion with natural gas. This combustion will then preheat the steel strip.
Project objectives

LIFE HICONOS project aims at demonstrating and validating a combustion system including an innovative rotating regenerator exchanger on Non-Oxidizing Furnaces (NOF) for steel processing lines by implementing a pre-industrial demonstrator on ArcelorMittal’s plant located in Mardyck, France.

Project beginning
The project was approved on June 1st, 2014

Project end
31st May, 2018

The HICONOS technology is intended to demonstrate at a pilot scale during this project, consists in replacing the classical recuperator by a rotating regenerator exchanger to preheat combustion air up to 1000 °C in order to:

• Decrease energy consumption of natural gas used to preheat the steel strip at the NOF.
• Decrease the CO₂ and NOx emissions produced during the combustion of natural gas.

A pre-feasibility study highlights the following potential benefits: Energy consumption of natural gas can be reduced by 23% from 180 kWh/ton to 140 kWh/ton of steel processed, so directly a reduction of CO₂ emissions by 23% representing savings more than 2 650 T of CO₂ per year, and a reduction of NOx by 10%.

This technology, following a successful demonstration in the HICONOS project, will have a very positive effect on the environment in general, and on climate change in particular.

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WHAT IS THE ROTATING REGENERATOR EXCHANGER?
The high efficiency of the exchange is obtained through alumina media packing, dispatched over a rotating cylindrical exchanger. Thanks to the slow rotation, the media is alternately heated up by waste gases from the furnace, and then cooled down by the combustion air. In consequence, the air is preheated up to 900 °C, a large part of the waste gases energy is then recovered, decreasing the global energy consumption.
Expected results

The project’s main expected results will consist in demonstrating the possibility of decreasing the carbon footprint of the current high energy intensive combustion system used in the steel industry. The innovative rotating regenerator exchanger technology, if successfully demonstrated, will not only enable us to save 12 GWh every year but it will also reduce drastically the CO₂ and NOx emissions of the sector.

If we consider the example of ArcelorMittal’s Mardyck Continuous Galvanizing Line (CGL), which is the demonstration plant chosen for this demonstration LIFE project, with the following characteristics:

• Nominal capacity to produce 350 000 tons of steel per year.
• Current NOF consumption of 181 kWh of natural gas per ton of steel.

Financed by

The project was co-funded by the European Union’s Life+ Program to encourage advances in innovative technologies with minimum environmental impact.

Partners

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