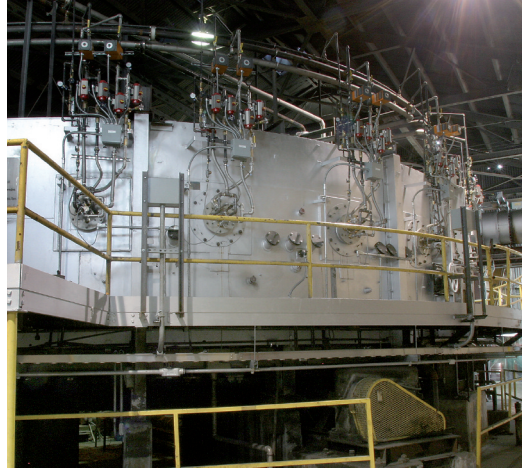




REBOX[®] oxyfuel solutions in reheating. 25% more throughput with 65% less fuel at ArcelorMittal Shelby, Tubular Products, USA.



ArcelorMittal is the world's number one steel company, with 310,000 employees in more than 60 countries.



After initial oxygen enrichment in 2005, full oxyfuel was implemented in 2007 for boosted capacity and additional fuel savings.

Summary

- Turnkey revamp of rotary hearth furnace
- 65% reduced specific fuel consumption
- 25% more capacity for billets, 150 mm (6") and larger
- 75% less emission of NO_x
- 4 month project and guaranteed performance

Customer

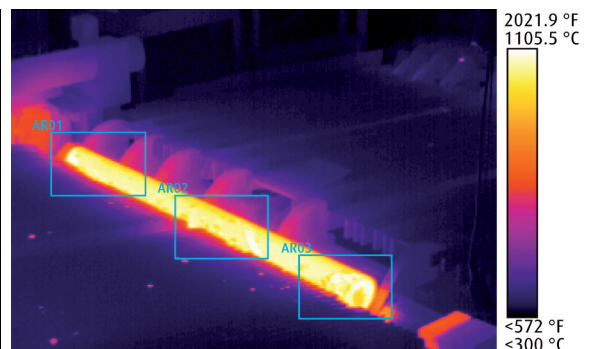
ArcelorMittal Shelby, Tubular Products Division, Ohio, USA

Background

ArcelorMittal Shelby manufactures precision welded and seamless tubular products for the automotive, industrial and construction equipment industries, recreation equipment, and for applications within oil. 640 employees manufacture approximately 207,000 tons of all of the principal types of steel tubing. Long bars are purchased and cut to length, cold charged, and reheated in the rotary hearth furnace prior to downstream piercing mill.

Customer objectives

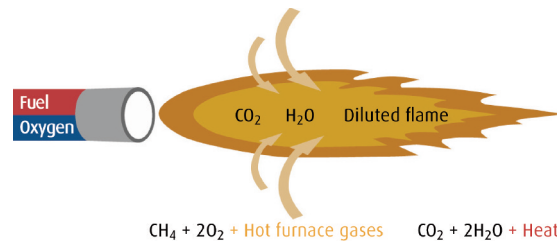
In 2005 ArcelorMittal Shelby together with Linde implemented oxygen enrichment to the existing airfuel combustion system to reduce the energy consumption of the existing rotary hearth furnace. Following the positive results of 29% fuel savings, in 2006 Shelby aimed to further reduce the energy costs but also to boost the seamless tube mill output especially for larger billet dimensions. In April of 2007, the contract was signed as ArcelorMittal Shelby concluded that full implementation of REBOX[®] oxyfuel solutions would be the only cost and time efficient solution to meet the pre-determined project targets.



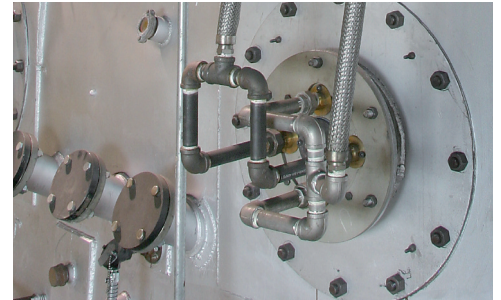
After revised heating profile the heating zones changed, two flue gas exits were closed and active pressure control implemented. Flameless oxyfuel has resulted in improved process yield with more uniform heating and reduced scale formation.

Flameless oxyfuel

Flameless oxyfuel combustion was employed for effective and uniform heating and to achieve low statutory NO_x emission levels. Flameless combustion is created by diluting the flame with the furnace gases, which in oxyfuel combustion contain no nitrogen ballast. The flame dilution also disperses the combustion gases throughout the furnace for more effective and uniform heating of the metal. The flame contains the same amount of energy as with conventional oxyfuel but with a lower flame temperature, thus the creation of NO_x is substantially reduced. The oxyfuel burners are dual mode. In the conventional mode, they heat up to 760°C (1,400°F). At this temperature level, fuel and oxygen will auto-ignite and thus the burner enters the flameless mode.



In flameless oxyfuel combustion, the flame is diluted with the furnace gases. This lowers the flame temperature and promotes more uniform heat distribution.



The patented range of flameless oxyfuel burners, both self-cooling burners with ceramic stone (as above) and water-cooled burners, are compact and powerful. The modular design facilitates inspection, service and upgrade.

REBOX® Installation/scope

- Turnkey project with Performance guarantee.
- Replacement of existing airfuel burners, 32 MW (109 mmBtu/hr) by ceramic self-cooled flameless oxyfuel burners, 17.9 MW (61 mmBtu/hr).
- Revised heating zones, from four to five zones, with appropriate temperature measurement.
- New combustion control system for fuel and oxygen.
- Flow trains for natural gas and oxygen.
- Closing two out of three existing flue gas exits, adding an active damper.
- Removal of two air-cooled baffles and combustion air blowers.
- From order to start-up 4 month project implementation time.

Customer benefits

- 25% overall capacity increase for billet dimensions 150 mm (6") and larger.
- 65% specific fuel savings.
- Improved temperature uniformity with 50% less temperature differences over billet length.
- 50% reduced scale formation.
- 75% lower emission of NO_x with same reduction of CO₂ as for fuel savings.
- Short, implementation period and on-time start-up.

REBOX® oxyfuel solutions

In more than 110 fully converted reheating and annealing furnaces, Linde's REBOX® oxyfuel solutions provide more throughput and flexibility at lower total costs.

- Up to 50% more furnace throughput capacity
- Up to 50–60% specific fuel savings
- More uniform heating and reduced scale formation
- Reduced emissions of such as CO₂ and NO_x

The broad REBOX® technology and application experience combined with long and detailed customer process experience results in fast and safe project implementation, also as turnkey and with guaranteed performance.