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

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 NOx
- 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 applications within the oil industry. Over 600 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 objective
In 2005, ArcelorMittal Shelby employed Linde to implement oxygen enrichment in the existing airfuel combustion system to reduce the energy consumption. Following the positive results of 29% fuel savings for that furnace, Shelby aimed to further reduce the energy costs and 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.

Flameless oxyfuel has resulted in improved process yield with more uniform heating and reduced scale formation.
Flameless oxyfuel combustion was employed for effective and uniform heating and to achieve low statutory NOₓ emission levels. Flameless combustion is created by diluting the flame with the furnace gases, which contain no nitrogen ballast in oxyfuel combustion. 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 conventional oxyfuel, but with a lower flame temperature, thus the creation of NOₓ 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.
- 4 month project implementation time from order to start-up.

**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 NOₓ.
- 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.

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