

# REBOX<sup>®</sup> oxyfuel solutions in reheating. Direct Flame Impingement (DFI) in a galvanizing line.



DFI oxyfuel for implementation in existing galvanizing line,  
at ThyssenKrupp Steel, Finntrop, Germany, 2006.

- Summary**
- DFI oxyfuel for highest possible heat transfer, 800–1000 kW/m<sup>2</sup>
  - 30% capacity increase
  - DFI oxyfuel unit effectively cleans strip, no strip pre-cleaning section is needed
  - No extension of furnace or line

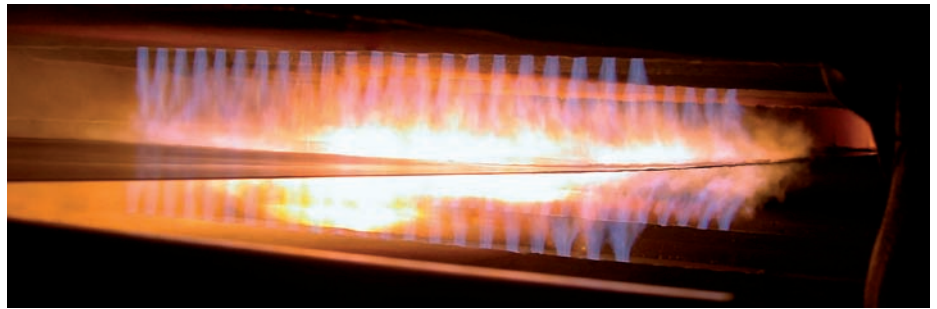
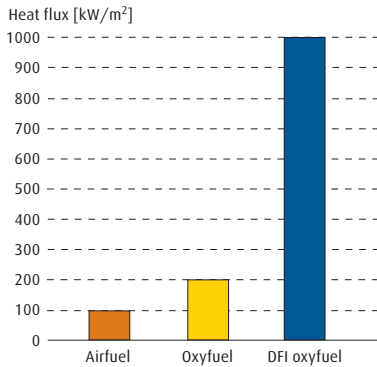
**Customer** ThyssenKrupp Steel, Finntrop, Germany.

**Background** ThyssenKrupp Steel (TKS) has been searching for a both easy to implement and effective solution in order to increase the galvanizing capacity of an existing production line at the Finntrop works. The galvanizing line at TKS Finntrop (FBA 3) processes both hot and cold rolled strip with a width of 650–1550 mm and thicknesses of 0.3–3.25 mm for automotive, white goods and construction applications. The total furnace length is 130 m, where 67 m is airfuel-fired. The highest strip speed is 180 m/min and the maximum output was limited to 82 tons/hour.

**Customer objectives** TKS had identified that by increased strip heating the line could reach 105 tons/h. It was also determined that the appropriate heating solution should free the strip surface from unwanted contaminants, such as emulsions, oils, grease and particles, which originate from the upstream strip production process. Another requirement was that the boosting unit should allow for strict control of the required surface properties needed for a successful galvanizing of the strip. With these specifications in mind, TKS met with Linde at the end of 2004 to discuss the possibilities of applying oxyfuel in galvanizing lines.

## DFI oxyfuel

Direct Flame Impingement (DFI) oxyfuel is based on Linde's vast experience in oxyfuel combustion and its application in steel heating processes. This expertise was adapted to continuous and large-scale use in reheating and annealing furnaces. With our DFI technology, where controlled oxyfuel flames are fired directly onto the moving metal, the heat transfer is drastically improved. Tests have verified the higher level with local heat flux for the DFI oxyfuel technology, reaching levels of 800–1000 kW/m<sup>2</sup>.



120 oxyfuel flames arranged in 4 burner row sets efficiently heats the strip.

## Features

- DFI oxyfuel unit, 5 MW, 120 oxyfuel flames from 4 burner row sets
- 80 – 90% thermal efficiency
- Compact unit size; 2.8 m long, 2.8 m wide and 1.2 m high
- 3 m of recuperative zone removed for installation of DFI
- Option for 2 more burner arrays, (+2.5 MW possible within the same outer dimensions)
- Complete safety and flow control system
- Automatic width adjustment
- Flow trains for natural gas and oxygen
- Installation, commissioning & fine tuning
- Guaranteed performance

## Benefits

- 30% more galvanizing capacity
- The oxyfuel flames effectively burn off and clean the strip from residues, oil etc.
- DFI oxyfuel effectively cleans the strip to remove strip pre-cleaning section (25 m)
- Specific fuel consumption reduced 6%
- No extension of line or furnace necessary
- Improved annealing properties over the entire strip width
- DFI oxyfuel allows for modification of metal surface properties
- Short installation time for a limited production down-time

## REBOX® oxyfuel solutions

In more than 90 installations in reheating and annealing furnaces, Linde's REBOX® oxyfuel solutions provide more capacity and flexibility at lower total costs.

Direct Flame Impingement oxyfuel is one of the leading solutions within the REBOX® portfolio. The broad REBOX® technology and application experience drives the development work and results in fast and safe project handling. We provide turnkey installations with guaranteed performance.



3 meter of the recuperative zone was used to fit the compact DFI oxyfuel unit.



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