Sustainable blast furnace gas firing in reheating furnaces

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Outline

- Motivation
- BFG-Based Combustion Systems
  - Preheated-BFG air-fuel burner
  - Double regenerative air-fuel burner
  - Preheated-BFG oxy-fuel burner
- Industrial implementation
- Conclusions

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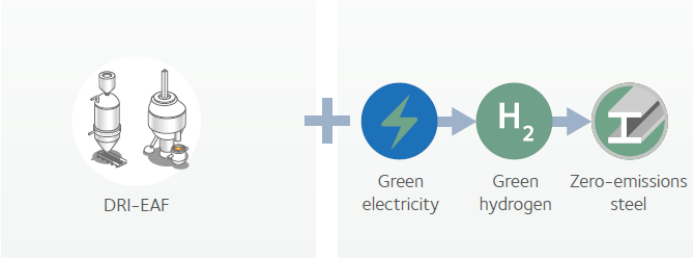
Motivation

- Necessity to increase competitiveness due to rising energy cost
  - Cut natural gas (NG) dependence
- Commitment with a sustainable steel production:
  - Reduction carbon footprint
  - Control NOx emissions
- Steelworks primary energy, carbon and NOx footprints can be reduced by using blast furnace gas (BFG)
  - Produced in huge quantities
  - Consumed internally in hot stoves, coke plant and steam boilers
  - Used in power generation
  - Reheating furnace may replace a big share of NG by BFG



✓ *Net-zero by 2050*

✓ *35% reduction in CO_2e emissions by 2030 in Europe*

Finishing operations:

- *~10% of carbon footprint*
- *30% in future DRI-EAF route*

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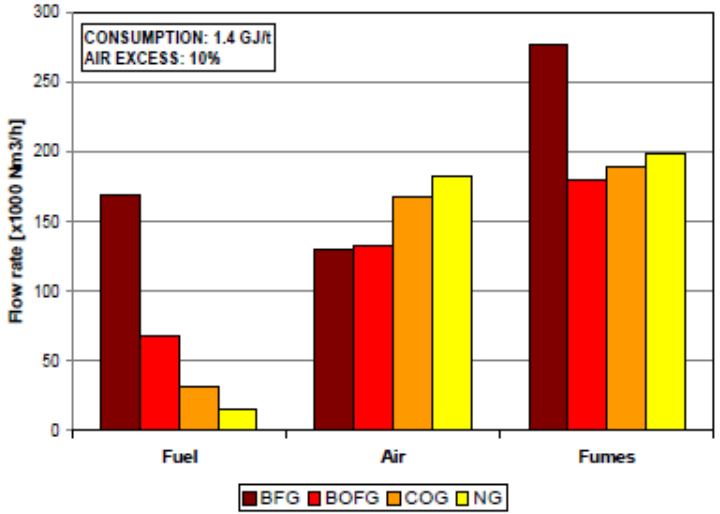
Blast furnace gas combustion

- Potential:
  - Reduction of natural gas dependence and related emissions
  - NO_X emissions reduction (lower peak flame temperature)
- Challenges:
  - Low calorific value
  - Low combustion efficiency
  - Low flues emissivity
  - High flue gases flow
- Opportunities:
  - Waste-heat recovery from flues
  - Oxygen enrichment / oxy-fuel
- Technologies:
  - BFG central preheating
  - Regenerative burners
  - Oxy-fuel burners



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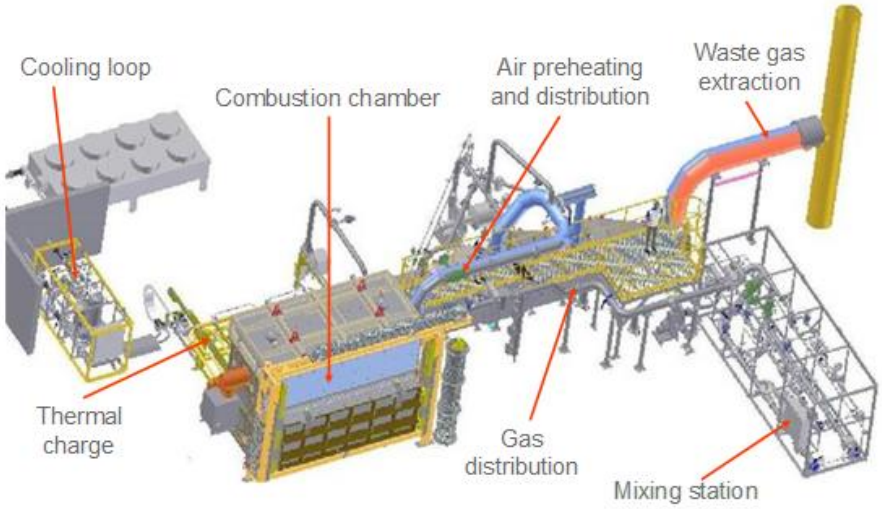
- 10+ years of operation
- Real process gases operation and hydrogen-ready
- 24/7 fully instrumented and automated
- Validation of solutions in an industrial environment
- Participation in several research consortiums



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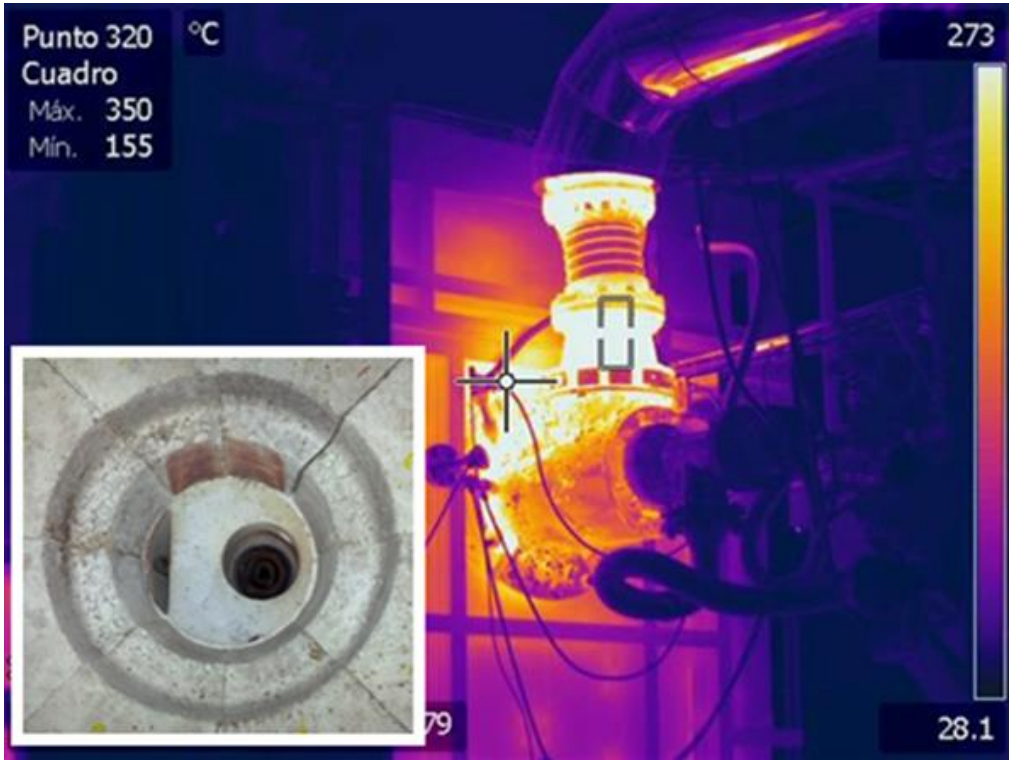
Preheated-BFG air-fuel burner



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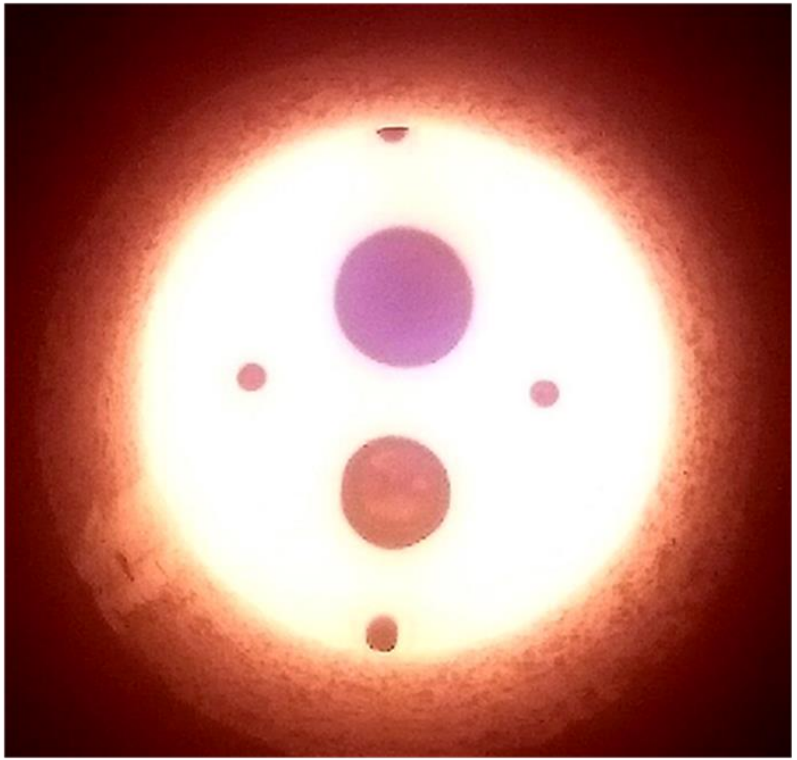
Preheated-BFG oxy-fuel burner



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Double regenerative air-fuel burner

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Industrial implementation: Asturias Wire Rod Mill reheating furnace

- Revamping by SMS Meer SpA
- 150 t/h walking beam furnace
  - Billets section 150/180
  - Billets length 12-15.2 m
- Retrofitted from 100% NG
  - Dual-fuel burners
  - Flexible operation:
    - 100% NG
    - 80% BFG (98%-vol.)
  - Preheated blast furnace gas
  - Additional waste gas duct
- In operation since 2015
  - 70% natural gas reduction
  - 40 kt/y CO_2 reduction


SMS Group press realease April 4 2016

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Conclusions

- Reheating furnaces can be operated with 100% BFG if the fuel gas is preheated, either with oxy-fuel burners or regenerative burners.
- NO_X emissions remain below the current limit established by the European regulation.
- BFG regenerators allow firing 100% BFG without oxygen supply or NG enrichment.
  - However, a post-combustor or regenerator purging is advisable in order to prevent the presence CO in the stack level.
- Long-term testing of real size burners at industrial and controlled conditions is very useful step before industrialization.
- Asturias Wire Rod Mill reheating furnace has been revamped in 2015 (70% natural gas reduction, 40 kt/y CO_2).

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Thank you!

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