

Heating and Burner technology Research and development analysis and findings

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Focus of investigations in reviewing: *heating and burner technology*

Specific

- Furnace and burner types
- Fuels and air preheating/heat recovery
- NO_x and GHG-Emissions

General

- Requirements of production on heating process



Main research topics and achievements

- Efficiency, energy consumption and CO₂ reduction
 - 30 to 40% by regenerative heat recovery
 - 9 to 14% Oxy-fuel combustion
 - 5 to 10% by furnace automation and control
- Process gases and fuel preheating
 - Substitution of NG, overall energy consumption in steel work reduced
- Productivity increase => specific energy consumption and CO₂ decrease
- NO_x-Emissions
 - Decrease from > 500 mg/Nm³ to below 100 mg/Nm³ (5% O₂ in exhaust) due to regulations



Best Available Technique for avoiding CO₂ in industrial heating

- Customized, optimized and well designed furnace
- Flameless, ultral LowNO_x combustion due to NO_x – emissions
- Heat recovery with regenerative or recuperative oxidizer-preheating:

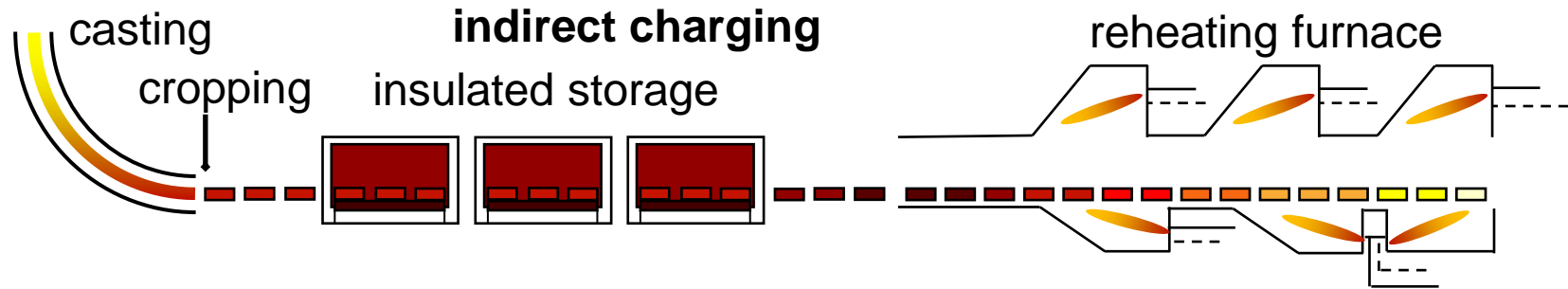
| Oxidizer | Preheating oxidizer |
|----------------------------------|---------------------|
| Air | Green |
| Oxygen enhanced combustion (OEC) | Yellow |
| Oxy-fuel (100 % Oxygen) | Red |

- Automation and control: temperature, oxygen control (dissHEAT project-topic 2 and 3)



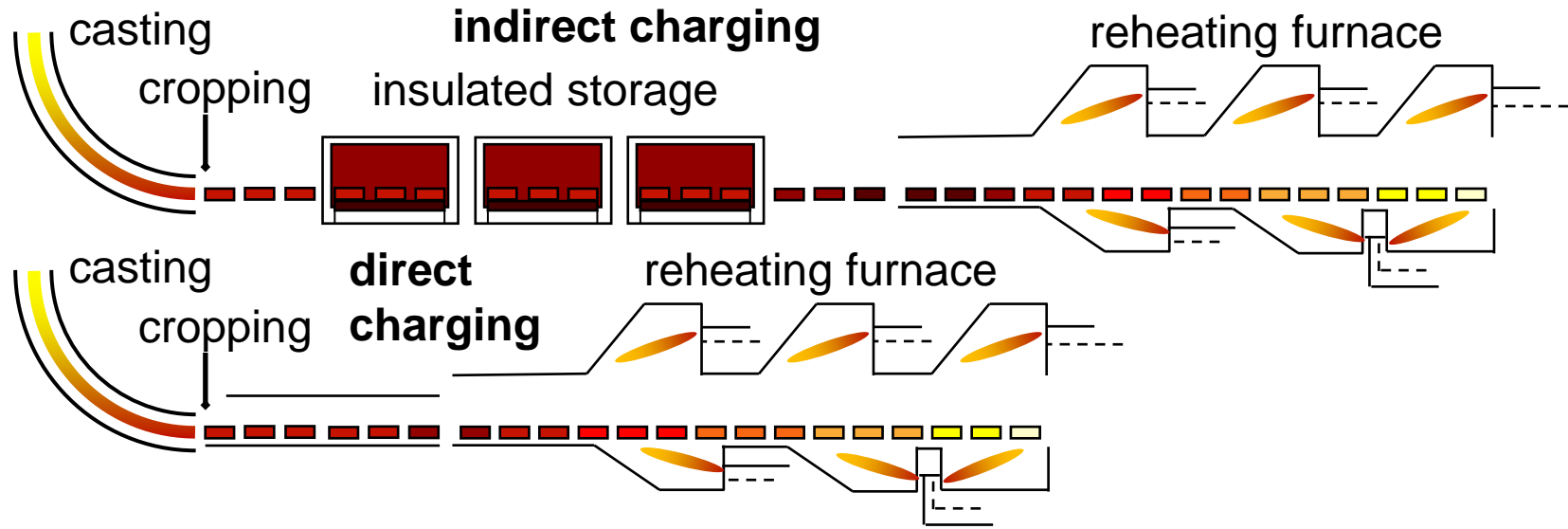
Process chain – Efficiency increase

1. casting not coupled with downstream: hot or warm charging



Process chain – Efficiency increase

1. casting not coupled with downstream: hot or warm charging
2. continuous casting and rolling: direct charging, combining rolling and casting

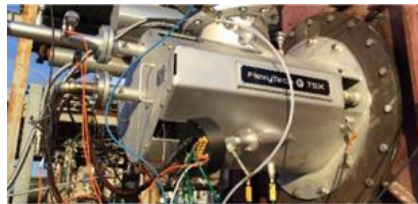


Relevant new technologies

- Relevant new technologies
 - Hydrogen combustion and alternative fuels
 - Hybrid (electrical and/or NG heating)
 - Electrical heating -> topic 5 – presentation



Source: <https://www.fivesgroup.com/steel/reheating/combustion-systems>



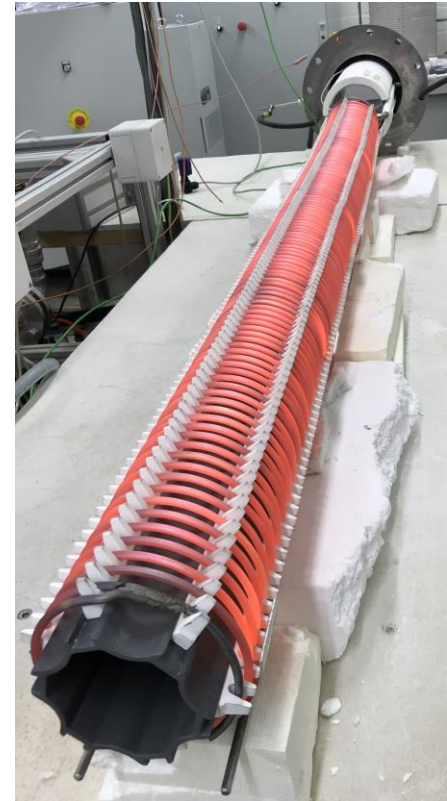
Source: <https://doi.org/10.1051/mattech/2022012>



Source: https://www.danieli.com/en/news-media/news/danieli-hydro-mab-take-step-ahead-green-steel_37_596.htm



Source: <https://www.sms-group.com/en-us/insights/all-insights/a-burner-for-all-mix-ratios-of-natural-gas-and-hydrogen>





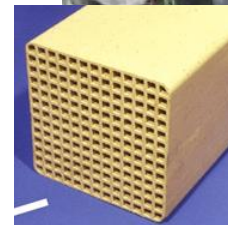
Thank you for the attention!

Stay informed
www.dissheat.eu

Research of past 25 years

Success story

- **Regenerative flat flame burner** developed in research projects for NG and process gases COG and BOF
- 300 regenerative burner systems sold worldwide for mainly batch type reheating furnaces.



Technology impact and integration research:

- **Heating** with new fuels, hybrid and combinations:
Hydrogen, biofuels, oxy-fuel, electrical heating (Topic 5)
=> Flameless or ultra LowNO_x combustion
- **Efficiency** with new technologies and heat recovery if applicable
Dark zone / heating with off gas
from new fuels, hybrid and combinations

| Oxidizer | Preheating oxidizer | Dark zone |
|----------------------------------|---------------------|-----------|
| Air | | |
| Oxygen enhanced combustion (OEC) | | |
| Oxy-fuel (100 % Oxygen) | | |



Technology impact and integration research:

Impact on **product and plant**

- Hydrogen combustion, electrical heating and combinations:
 - Influence on product-material, temperature uniformity, scaling
 - Influence on furnace and heating equipment when technologies are combined: i.e. high H₂O content in exhaust gas
=> influence on resistance heaters
=> influence on refractory and insulation
 - **Security when handling H₂**

