Developing and enabling H2 burner utilization to produce liquid steel in EAF

RFCS-02-2020-RPJ

GA number: 101034081

01/07/2021-31/12/2024

The research leading to these results has received funding from the European Union's Research Fund for Coal and Steel research program under grant agreement number: 101112264

General information

Name	Developing and enabling H2 burner utilization to produce liquid steel in EAF
Acronym	DevH2EAF
GA Number	101034081
Start Date	01-07-21
End Date	31-12-24
Duration	42 months
Coordinator	Rina-CSM
Partners	RWTH-IOB, FENO, SMS, NipponGases, Beltrame, CELSA

Scope of the project: Realization and testing of innovative H2 burners to be adopted in EAF.

Main tasks:

- Designing of innovative burners
- Preliminary risk analysis for Hydrogen use in EAF
- Tracking the performance of hydrogen burner in replacement of methane or other carbonaceous fuels through laboratory trials and industrials trials
- Studying of actual performance of H2 burners with the definition of future improvements

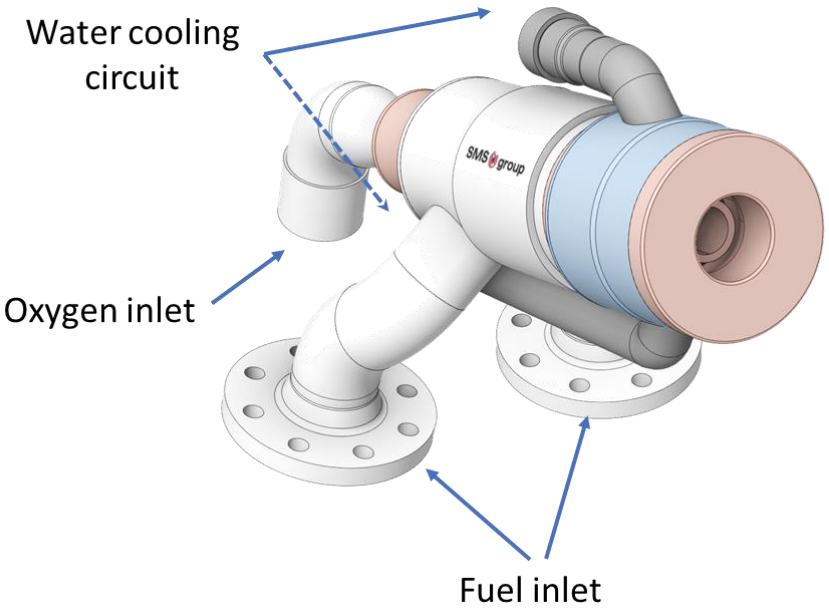
Project activities

1) Design and realization of EAF burners, able to work with NG/H2 mixture, up to 100% hydrogen (SMS)
2) Design and realization of H2 pipeline from the tube trailer to EAF in safety conditions (NG Ind.)
3) Experimental trials at lab and pilot scale (RWTH and CSM) an at two industrial sites (FeNo and CELSA).

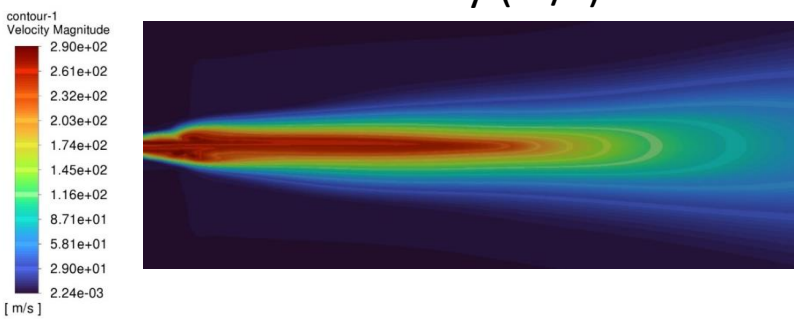
Design and realization of EAF burners, able to work with NG/H2 mixture, up to 100% hydrogen (SMS)

The CFD analysis results of burner at 3 MW with 100% hydrogen show:

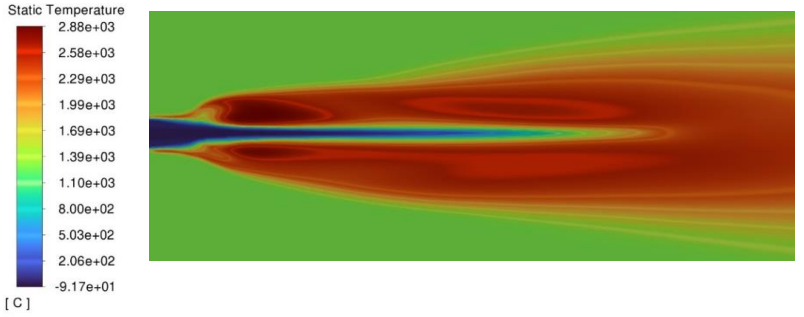
1) The combustion of hydrogen is complete in less of 2 meters.
2) The central oxygen jet remains stable, improving the stability of the flame, being the oxygen the stream that guides the remaining fuel flow rate.
3) The fast ignition favors the mixing of oxidant and oxidizer.
4) The high speed of the central oxygen permits to produce an elongated flame with a progressively combustion through the entire length of the jet reducing the heat load on the burner head.



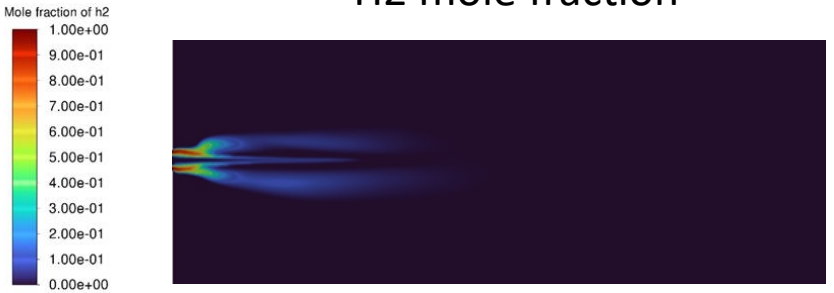
Velocity (m/s)



Temperature (°C)



H2 mole fraction

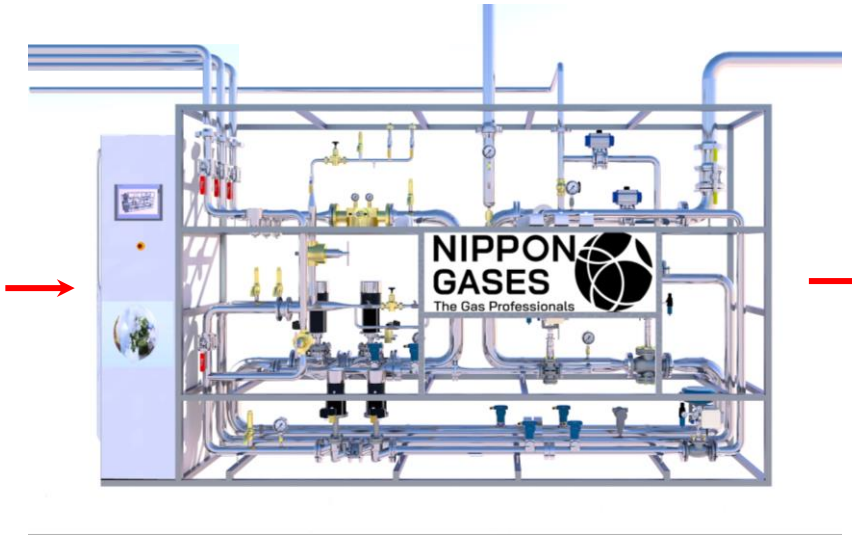


Design and realization of the fuels supply system and pipelines design (Nippon Gases Industrial)

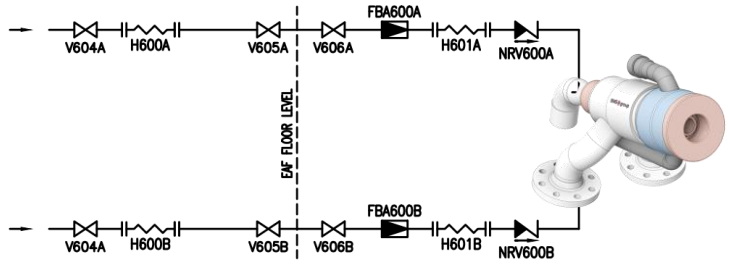
1) Hydrogen high flowrate tube trailer with decompression system.
2) Hydrogen pipeline design.
3) Fuel Supply Regulation System (FSRS) to mix various percentage of H2 and NG.
4) Flash-back arrestors system to protect the equipment from damage or explosion.
5) SIL3 design for stoichiometric ratio control.

Hydrogen high flowrate tube trailer

Hydrogen decompression system



FSRS



Flash-back arrestors system (P&ID)

EAF Burner

Experimental trials at lab and pilot scale (RWTH and CSM) an at two industrial sites (FeNo and CELSA).

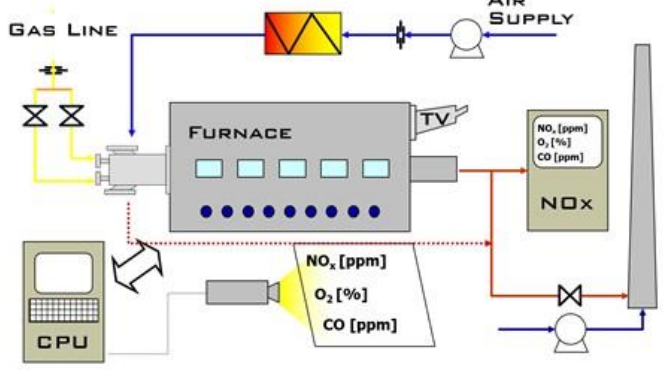
1) Pilot trials on **RINA-CSM** combustion chamber to investigate the heat transfer, temperature profile into the burner, chemical composition of off gas (O_2, CO_2, H_2O, CO and NOx).
2) Prototype burner on 600kW pilot EAF in **RWTH** premises with pure NG (reference) as well as mixtures of H2-NG up to 100% H2 operation. The trials will be used to investigate the off-gas composition hydrogen pickup of the melt.
3) The experimental campaigns at **FeNo** and **CELSA**

RWTH 600kW pilot electric arc furnace plant

- *Transformer rated power: 850 kVA*
- *Secondary voltage: 250 850 V in 10 steps*
- *Arc current: max. 2 kA*
- *Active power: max. 600 kW*

RINA-CSM combustion Chamber

Maximum Fuel flow rate: 300 Nm3/h of NG, 2000 Nm3/h for syngas compositions
Pollutants Monitoring and Recording: O2, CO, CO2 & NOx
Control System of furnace
Flow rate, Pressure and temperature monitoring and recording
Continuous Video Monitoring



Burner position in Ferriere Nord EAF

Capacity : 148t
Dimensions 7100 mm diameter
Installed Power 130 (+10%) MVA
Tap to tap time 46'
Yearly production 1.5 Mt/y