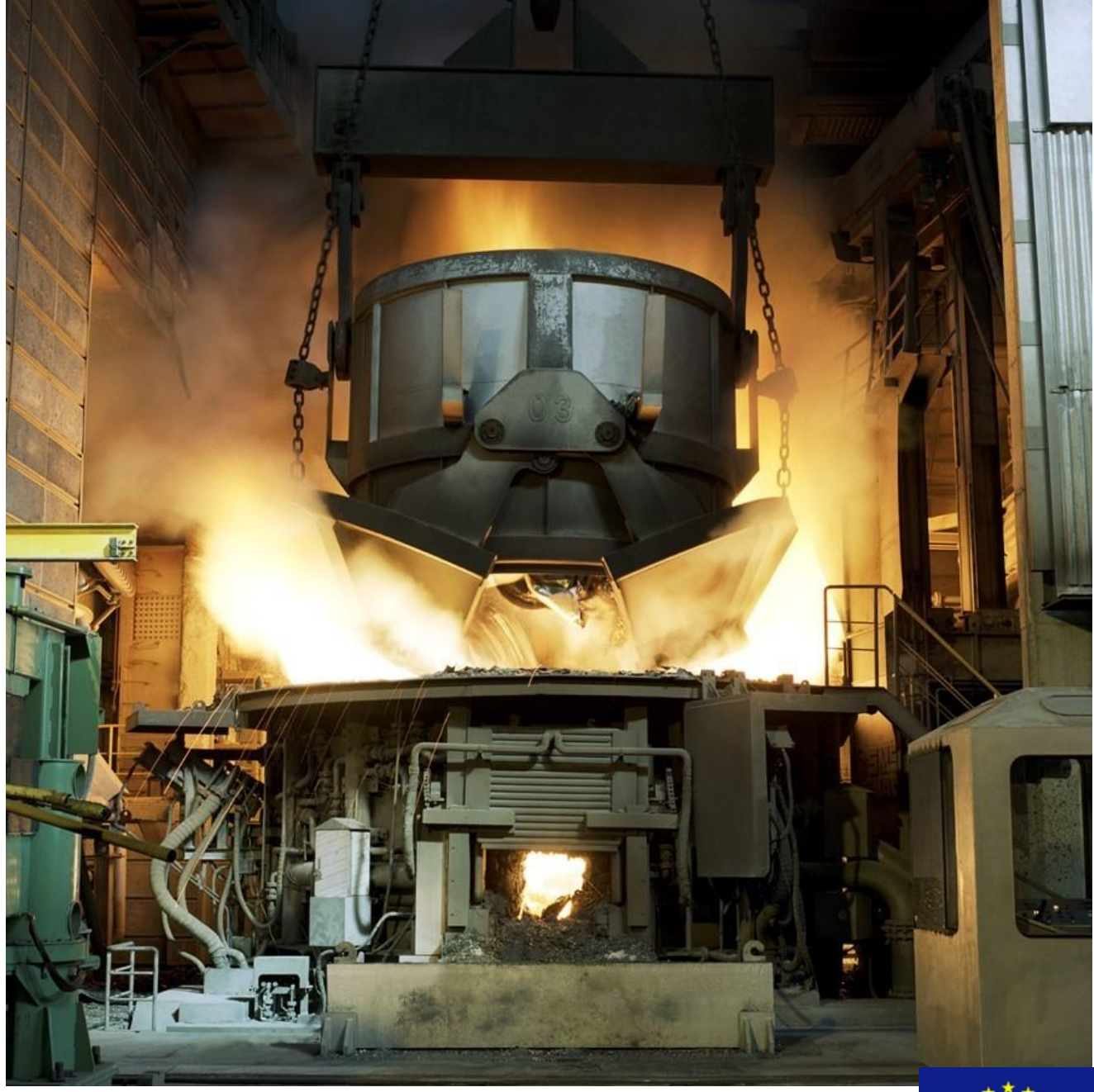
Dev H2 for EAF



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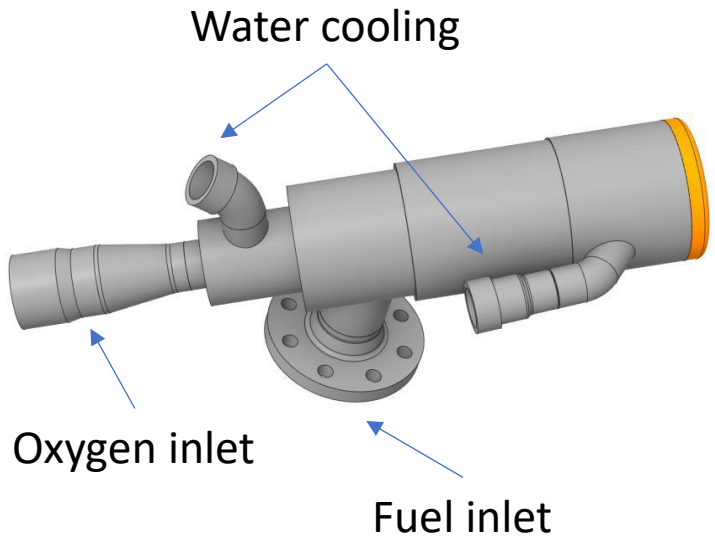
Burner technology and combustion equipment

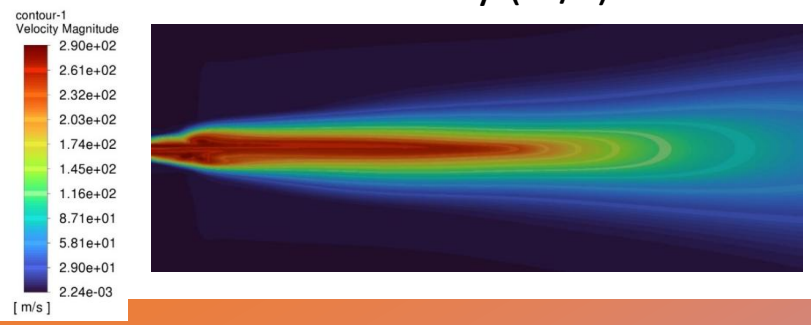
Design and construction of the H_2 injector-burner

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

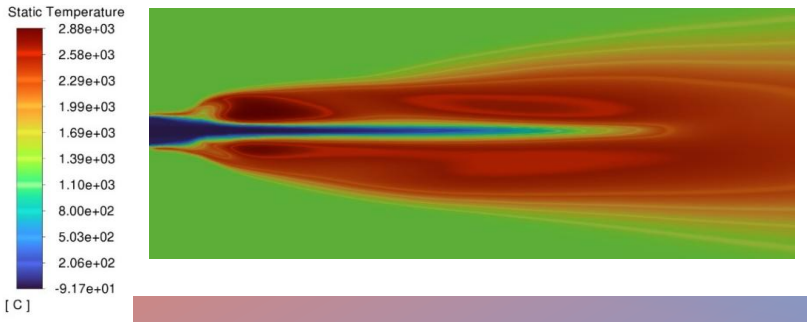
1) The combustion of hydrogen is complete in less of 2 meters.
2) The central oxygen jet remains stable, improving the stability of the flame, being the oxygen the stream that guides the remaining fuel flow rate.
3) The fast ignition favors the mixing of oxidant and oxidizer.
4) The high speed of the 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.



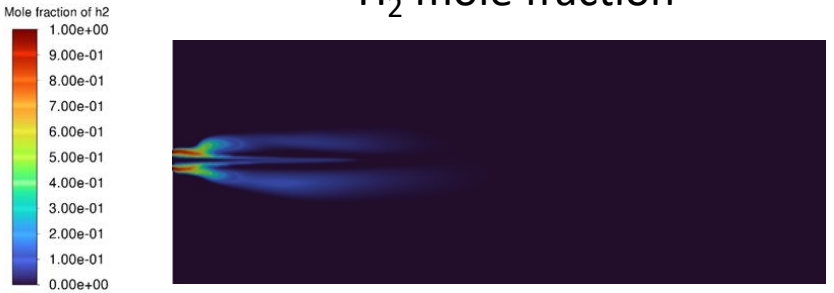
Velocity (m/s)



Temperature (°C)

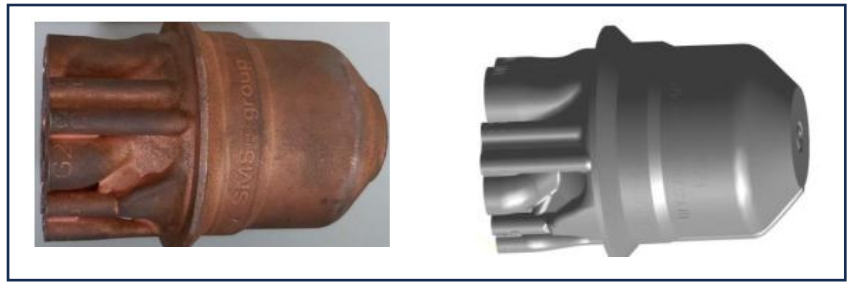


H_2 mole fraction

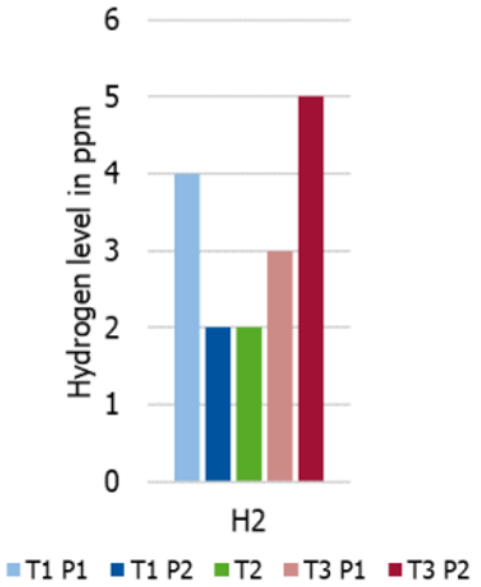


Impact of H_2 burner on the steel composition Experimental trials in pilot scale EAF

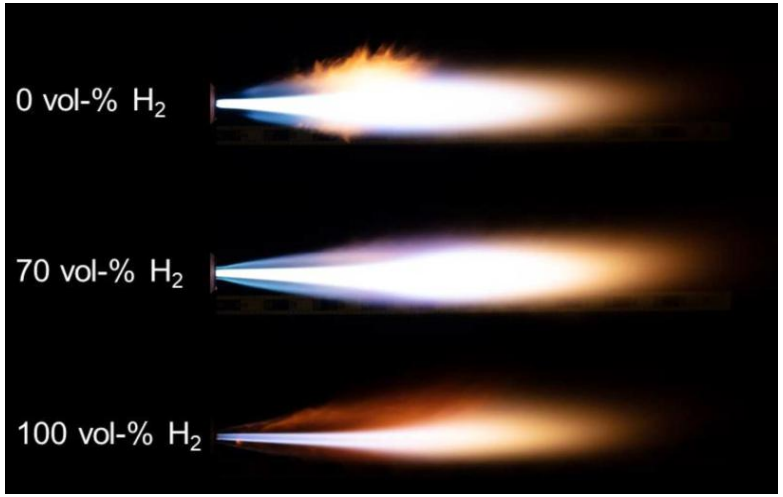
The burner with a power of 50 kW has been tested in a pilot scale EAF with an active power of 600 kW and 2000 A of maximum arc current. The burner is able to combust different fuel gases and their mixtures ranging from 100% natural gas (NG) to 100% hydrogen (H_2).
The flame with 100% hydrogen in the fuel gas is visible, due to particles present in the ambient atmosphere which accumulate in the long exposure picture. The results of the analysis show that the H_2 content in the steel remined within the range of 2-5 ppm.



Small scale prototype – 50kW



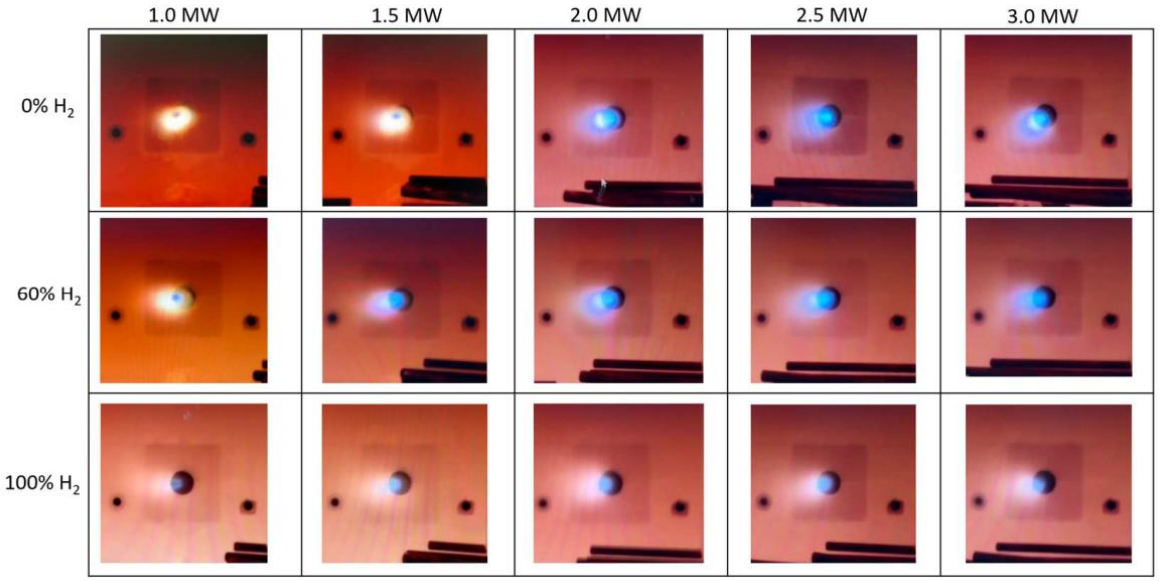
Trial 1 before the burner ignition
Trial 1 at the end of the operation
Trial 2 at the end of the operation
Trial 3 before the burner ignition
Trial 3 at the end of the operation



Burner technology and combustion equipment
Experimental campaign with Oxyfuel burner at RINA-CSM pilot plant

The **experimental campaign** with an Oxyfuel burner has been conducted, at the RINA-CSM combustion chamber in Dalmine, to evaluate performance and feasibility of the H_2-burner with different fuels supplies: from 100% NG to 100% Hydrogen, including mixed configuration of NG-H_2. The fuel mixing was performed by a dedicated mixing regulation system developed by Nippon Gases

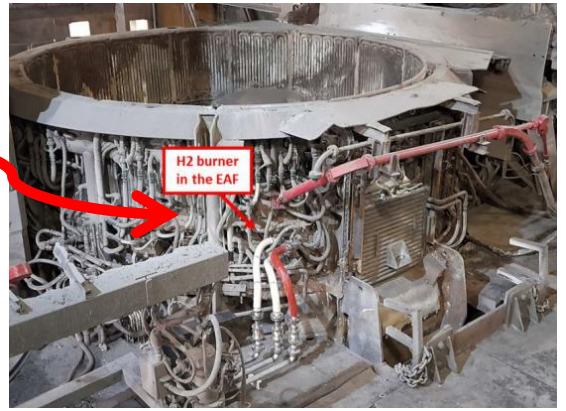
Length (internal)	[m]	3 – 7.5
Cross Section	[mm] x [mm]	2000 x 2000
Maximum Burner Capacity	[$MW_{gas\ based}$]	3
Maximum NG Flow Rate	[Nm^3/h]	300
Maximum Syngas Flow rate	[kg/h]	2000
Maximum Air Flow Rate	[Nm^3/h]	3500
Maximum Working Temperature	[°C]	1250
Thermocouples for measuring longitudinal temperature profile along burner axis;		
Pollutants Monitoring system for O_2, CO & NOx;		
Computer Controlled System		
Continuous Video Monitoring		



Burner technology and combustion equipment

INDUSTRIAL trials with Oxyfuel burner

Process Data	FENO
Capacity (t)	147 t liquid
N° of burners	8 NG burners+3 sidewall lances (in the first stage burners - in the last lances)
Max burner power (MW)	4
N° of Tuyeres	3 (bottom)
Max tuyere power (MW)	1
N° of Jet burners	4
Max Jet burner power (MW)	3
N°of C injectors	3
N°of polymers injectors	1
N° lime injectors	2
N° white slag injectors	2

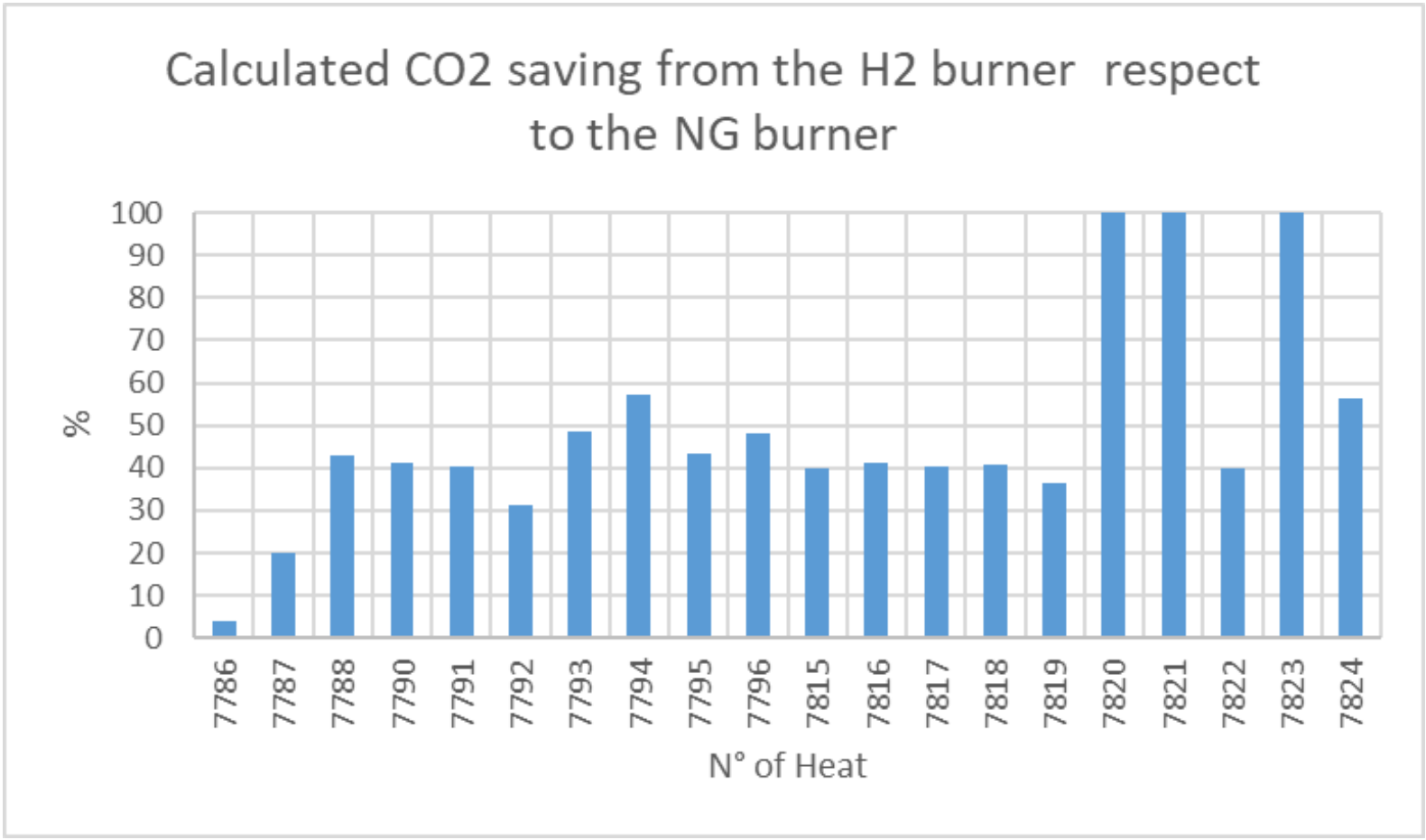


The **industrial campaign** at the Ferriere Nord Electric Arc Furnace (EAF) aimed to evaluate the feasibility of using a hydrogen (H_2) burner to replace one of the existing natural gas (NG) burner.
The Ferriere Nord EAF has a capacity of 147tons. It is equipped with 8 natural gas burners of 4 MW, 4 jet burners of 3 MW, and 3 bottom tuyeres fed with oxygen. Additionally, the furnace is equipped with injectors for slag reducing agents and slag conditioners.

Industrial campaign at FeNo in EAF results confirmed the burner stability and its correctly working up to 4 MW with 100% H_2.

Emissions

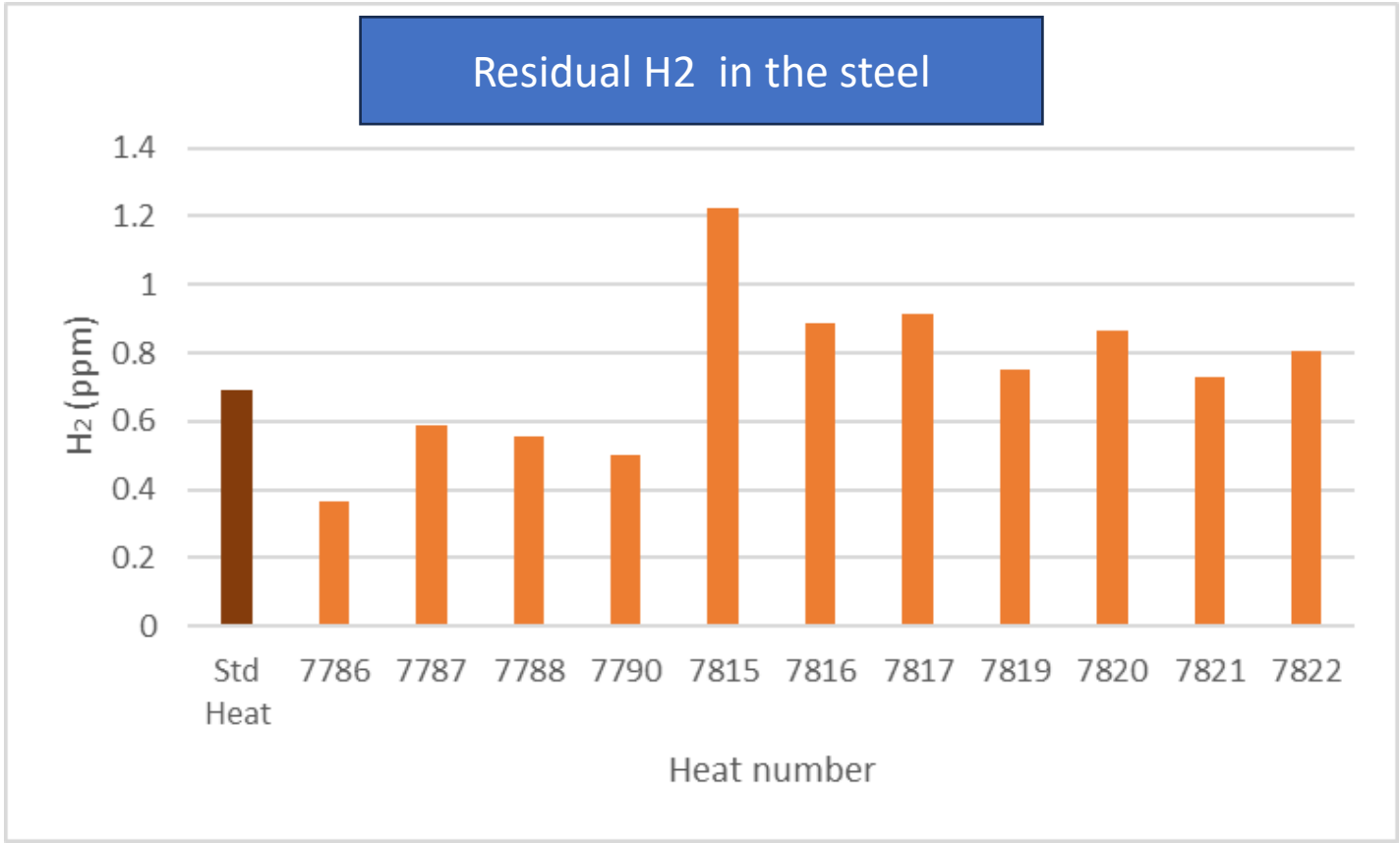
INDUSTRIAL trials with Oxyfuel burner



Industrial campaign at FeNo in EAF results showed an average CO_2 reduction of 48% due to NG use during the anti-splash phase, while 100% reduction was reached in three heats where only hydrogen was used throughout.

Impact of H_2 burner on the steel composition

INDUSTRIAL trials with Oxyfuel burner



Industrial campaign at FeNo in EAF results confirmed that residual H_2 in steel samples in LF remained below 2.0 ppm

ACKNOWLEDGMENTS

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Thank you for your attention

For further information visit the website
https://www.devh2eaf.eu/