Postdoctoral fellow position at CORIA
(UMR 6614 CNRS – Université Rouen Normandie – INSA Rouen Normandie)

2022 – 2023

An experimental study of hydrogen combustion for the decarbonation of bricks and tiles manufacturing sector

CORIA is an academic research laboratory, joint research unit (UMR) attached to the Institute of Engineering and Systems (INSIS) of CNRS, the Université Rouen Normandie and INSA Rouen Normandie. CORIA researches cover fundamental and applied studies on reactive and complex flows, especially in combustion, metrology and laser sources, and numerical simulation. Through multi-physics and multi-scale approaches, research in fluid mechanics are conducted with or without chemical reaction by combining theoretical studies, modeling, numerical simulations and experiments at different scales with a striking specificity in the development and application of optical and laser diagnostics. The physical mechanisms and processes leading to the reduction of pollutant emissions in reactive systems and the decarbonation of energy, propulsion, and industry by 2050 are its research priorities.

CORIA is a member of the Carnot ESP (Energy and Propulsion Systems) Institute. The French label 'Institut Carnot' is the recognition of the ability of research structures to collaborate effectively with socio-economic partners, with a level of quality consistent with the best international standards.

The bricks and tiles industry is an energy intensive processing industry using mainly natural gas, which emits carbon dioxide during products manufacturing, around 700 tons of CO_2/year in France. International commitments and national regulations fix the path of the phasing-out of fossil resources use and their replacing by renewable energies, as well as the objectives of 40% reduction in 2030 of greenhouse gas emission (1990 base) and the reaching of carbon neutrality circa 2050. Among different scenarios for such large decarbonation, the use of green hydrogen (i.e. produced from renewable sources) as fuel is one of the most promoted solution for intensive energy process such as bricks and tiles manufacturing sector. However, the transition of fuel from natural gas to hydrogen in a combustion system will have different impacts on the process that require being experimented, analyzed and characterized. These impacts would be at different levels on the flame itself, its thermal transfer to the products and the quality of the latter.

The aim of the 'HyDéTOP' project gathering Centre Technique pour les Matériaux Naturels de Construction (CTMNC), CLEIA company and CORIA lab, is to characterize these impacts in order to be

able to support the industrial sector towards hydrogen combustion. This project is funded by ADEME, French public agency for ecological transition.

Within this framework, the recruited PostDoc researcher will work at CORIA to participate to the experimental study of the effect on flame features of the transition from methane to hydrogen as fuel in turbulent combustion configurations, representative of bricks and tiles sector.

This study will be done in two steps. Firstly, Chemiluminescence imaging will be implemented in one partner's R&D center in a real-size burner configuration at nominal operating conditions. Modification of flames structures with the variation of H_2 content in natural gas – hydrogen blend will show the changes in turbulent flame stabilization modes and heat source locations when progressively transitioning fuel composition from natural gas to hydrogen.

In the second part of the study, a similar burner configuration will be downscaled at moderate thermal power (around 25 kW) for the lab-scale experiment in CORIA lab. Flow velocity measurements by Particle Image Velocimetry (PIV) will be performed to determine aerodynamics features at the burner exit and in the flame. OH Planar Laser Induced Fluorescence (PLIF) will give instantaneous images of reaction zones in the flame. All the results and their analysis will point out in details the turbulent flame stabilization process and its variation with CH_4-H_2 blend composition up to pure hydrogen flame. The impact of oxygen addition in air will be also studied with similar methodology and optical diagnostics.

Lastly, these results on flame characterization can be linked with the study of the impact of hydrogen on products quality that will be also realized by other partners within the HyDéTOP project.

Keywords: hydrogen, combustion, burner, optical diagnostics, PIV, LIF

Required skills

Applicants will hold a PhD degree in Physics or Mechanical Engineering. Strong background and experience in experimental study in fluids mechanics (reactive or not) and/or optical diagnostics will be considered. Ability to work in a team on collaborative projects. Finally, fluency in spoken and written French or/and English is a requirement.

Duration: 1 year (extendable)

Salary: from 2690 €/month (gross salary) depending on experience

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