

Combura 2023

October 23 & 24, 2023

Domusdela, Kanaalstraat 4, 5611 CT Eindhoven, The Netherlands

Update 2 (with new workshop info and two posters added)

Update 3 (with time of NVV meeting and conference dinner added)

GENERAL INFORMATION

The COMBURA symposium stands as a pivotal annual event fostering the exchange of insights within combustion research and its tangible applications in the Netherlands. It is an initiative of the Nederlandse Vereniging voor Vlamonderzoek NVV (Netherlands Association for Flame Research).

This year the general theme is *Impact of open research on industrial combustion*. Participants from universities, research institutes, and industrial companies in the Netherlands and surrounding countries are invited.

The COMBURA event starts in the late afternoon of October 23rd with the NVV Members Meeting (17:00-19:00). NVV members will receive a separate invitation for this meeting. The COMBURA conference dinner will be served starting at 19:30 (It is open for all COMBURA participants, but registration is required). After the dinner conversations can be continued at the bar. Participants can stay overnight provided that a reservation was made.

On October 24th, a symposium is held with various type of lectures and workshops. The COMBURA theme is addressed in different ways: by plenary lectures on combustion technologies with high industrial relevance, by contributions of industrial researchers on problems they want to bring in focus, and by a workshop offering joint discussion and hands-on experience with the industrial problems solving. A Book of Abstracts will be made available to the participants.

Registration for the conference and for the conference dinner is possible via links provided at the Combura website (www.combura.nl).

There also further information on venue and accommodation can be found.

CONTACT

For any question regarding the Symposium: contact Marjan Beekmans at m.beekmans@tue.nl

Program Committee

- Francesca De Domenico, Delft University of Technology
- Domenico Lahaye, Delft University of Technology
- Jeroen van Oijen, Eindhoven University of Technology
- Dirk Roekaerts, Delft University of Technology

Organizing Committee

- Domenico Lahaye, Delft University of Technology
- Marjan Beekmans, Eindhoven University of Technology

PROGRAM OUTLINE

Plenary session

8:45 WELCOME

9:00-9:40 KEYNOTE LECTURE by **Anh Khoa Doan**
MILD Combustion: overview of current research and challenges

9:40-10:20 KEYNOTE LECTURE by **Christine Rousselle**
Ammonia, the other hydrogen for clean thermal applications

10:20-10:40 *Break (Coffee, tea, soft drinks, snacks)*

10:40-11:40 INDUSTRIAL COMBUSTION PROBLEMS, part I

The session on industrial combustion problems wishes to promote the dialogue between industry and academia. In the first part, challenges in the operation and design of industrial furnaces are explained by three industrial partners:

Christine Bertrand (Origen Carbon Solutions): Vertical shaft convertor for the calcination of lime.

Sethu Ramalingan (Danieli-Corus): Furnaces for the production of hot blast used as preheated oxidizer for hot blast stoves used in the production of steel.

Dmitry Gyrontsev (CelSian): Furnaces for the production of glass.

The second part is a workshop part of the afternoon program.

11:40-13:00 Poster session

13:00-13:45 *Lunch*

Parallel sessions

14:00-15:00 Oral presentations and workshop in parallel sessions (see next page)

15:00-15:20 *Break (Coffee, tea, soft drinks)*

15:20-16:20 Oral presentations and workshop in parallel sessions (see next page)

In the workshop on INDUSTRIAL COMBUSTION PROBLEMS Combura participants can learn and join the discussion on how to best address the challenges of industrial combustion.

More information can be found at: <https://tinyurl.com/combura-2023-workshop-updates>

Plenary session

16:30-17:00

The results and recommendations of the industrial combustion workshop will be reported. Then, the winner of the NVV Combustion Award 2023 will be announced. This award is given to the young expert with the best Master Thesis in the field of combustion technology. Finally, the three best posters presented at the symposium will receive an award from the Dutch Section of the Combustion Institute (DSCI).

17:00 *Drinks*

KEYNOTE LECTURES

Keynote lecture 1

By **Anh Khoa Doan**, Assistant Professor in AI for Fluid Mechanics, Aerospace Engineering, Delft University of Technology.

MILD Combustion: overview of current research and challenges

Moderate or Intense Low-oxygen Dilution (MILD) combustion (also called flameless combustion) has been a topic of research for the last few decades thanks to its potential in reducing pollutant emissions such as NO_x. Such combustion regime is achieved by a combination of preheated reactants and low O₂ concentrations and is then generally characterized by lower peak temperatures and distributed reaction zones, thereby decreasing temperature gradients, acoustic oscillations, and NO_x emissions. Despite the more than 25 years since the first description of this combustion regime, several aspects of MILD combustion remain to be fully understood preventing the wider application of such combustion regime to, for example, gas turbines.

In this talk, the fundamental aspects of MILD combustion will be first introduced. Then an overview of recent research will be presented focusing on: (i) works that attempted to provide a rigorous definition of what constitutes the MILD combustion regime, (ii) experimental configurations which achieved MILD combustion conditions and (iii) efforts in the development of accurate numerical model for the simulation of MILD combustion.

Keynote lecture 2

Christine Rousselle, University of Orléans

Ammonia, the other hydrogen for clean thermal applications

The objective to reach neutral carbon footprint in 2050 accelerates the energy transition. Industries and scientists collaborate for developing zero CO₂ emission solutions for all energy sectors: power, transport and industry. Hydrogen and hydrogen derived fuels, 'e-fuels' will play an important role. Ammonia, one of the simplest electro fuels, is a promising candidate as energy and hydrogen carrier, but it can also be used directly as a zero-carbon fuel, pure or mixed with hydrogen or biofuels. However, the combustion properties of ammonia are far from those of conventional fuels and are not well known. During this talk, the state of art of ammonia combustion will be presented with focus on the remaining challenges. Both fundamental aspects and application issues will be addressed.

ORAL PRESENTATIONS AND WORKSHOP

	SESSION I	SESSION II	SESSION III
14:00-14:20	Gabriela Sanchez	Claudia-Francisca Lopez-Camara	WORKSHOP ON INDUSTRIAL COMBUSTION PROBLEMS
14:20-14:40	Victor Vloeberghs	Kaushal Dave	
14:40-15:00	Diego Quan	Stijn van Rijn	
15:00-15:20	BREAK	BREAK	BREAK
15:20-15:40	Maria Rosaria Acquaviva	Jesse Hameete	WORKSHOP ON INDUSTRIAL COMBUSTION PROBLEMS
15:40-16:00	Patrick Hemmen	Mark Hulsbos	
16:00-16:20	Jesse Hofsteenge	Shyam Sundar Hemamalini	

Parallel Session I

Effect of temperature and pressure on lean turbulent hydrogen flames

Gabriela Sanchez, Jeroen van Oijen
Eindhoven University of Technology

LES of lifted hydrogen flame through transported PDF method

Victor Vloeberghs, Gioele Ferrante, Ivan Langella, Dirk Roekaerts
Delft University of Technology

DNS and LES of temporal mixing layers of hydrogen combustion for the Argon Power Cycle

Diego Quan, Alessandro Ballatore, Jeroen van Oijen
Eindhoven University of Technology

Effect of high strain on hydrogen ultra-lean premixed flamelet

Maria Rosaria Acquaviva, Ivan Langella
Delft University of Technology

Flame Flashback Behavior when Subjected to Pressure Peak at Ignition Conditions - Comparison Between Hydrogen and Metha

Patrick Hemmen
Bosch Thermotechniek B.V.

Numerical Analysis of Sensitivity of Cyclone Burner FTF to Swirl Intensity Variation

Jesse Hofsteenge, Jim Kok
University of Twente

Parallel Session II

Gas-phase synthesis of iron oxide nanoparticles produced via diffusion flames

Claudia-Francisca Lopez-Camara, Juliana Davoglio Estradioto, Sabrina Schleich, Paolo Fortugno, Hartmut Wiggers
University of Duisburg-Essen; Northwestern University

Investigation of size-informed droplet transport using Mie-scattered imaging and Interferometric particle imaging

Kaushal Dave, Francesca De Domenico, Fulvio Scarano, Arvind Gangoli Rao
Delft University of Technology

The effect of hydrogen addition on the wavelength depending absorption of combustion generated nanoparticles from premixed ethylene flames

Stijn van Rijn, Merel van Helten, Martijn Goudberg, Anatoli Mokhov, Ulrike Dusek
University of Groningen

Particle resolved hyperspectral pyrometry measurements of burning iron particles

Jesse Hameete, Muhammed Abdallah, Leon Thijs, Tess Homan, XiaoCheng Mi, Nico Dam, Philip de Goey
Eindhoven University of Technology

Burning velocity measurements for flat hybrid iron-methane-air flames

Mark Hulsbos, R.T.E. Hermanns, R.J.M Bastiaans, L.P.H. de Goey
Eindhoven University of Technology

Modelling the interaction of burning iron particles and turbulence

Shyam Sundar Hemamalini, Jeroen van Oijen, Benedicte Cuenot, XiaoCheng Mi
Eindhoven University of Technology

Parallel session III

WORKSHOP ON INDUSTRIAL COMBUSTION PROBLEMS part 2

More information can be found at: <https://tinyurl.com/Combura-2023-workshop>

POSTER PRESENTATIONS

Large Eddy Simulation of a Lean Premixed Swirl-Stabilized Combustor

Giacomo Abbasciano, Gioele Ferrante, Ivan Langella, Arvind Gangoli Rao
Delft University of Technology

Investigation of dual fuel (methanol/diesel) setup for industrial diesel engine

Frank Ahout, Edward Goossens, Bahram Nourani
HAN University of Applied Sciences

FGM modelling of H₂-Ar-O₂ turbulent reacting mixing layers

Alessandro Ballatore, Jeroen van Oijen
Eindhoven University of Technology

Reactor Modeling of Hydrogen Flash Reduction of Magnetite particles

Bharat Bhatia, Benedicte Cuenot, Jeroen van Oijen, XiaoCheng Mi
Eindhoven University of Technology

Combined effect of strain and water injection in lean premixed hydrogen flamelets

Biagio Cassese, Alessandro Porcarelli, Ivan Langella
Delft University of Technology

Numerical characterization of high-pressure hydrogen injections for compression-ignition engines

Nick Diepstraten, Bart Somers, Jeroen van Oijen
Eindhoven University of Technology

1D Acoustic Network Modelling of a Cyclone Burner with Different Swirl Numbers Using taX Software

Berksu Erkal, Jim Kok
University of Twente

A high fidelity simulation framework for intensified biomass gasification

Anna Felden, Wiebren De Jong
Delft University of Technology

Iron particles ignition in hot coflow

Giulia Finotello, Yuri Shoshin, Philip De Goey, Muhammed Abdallah
Eindhoven University of Technology

BALANS: Renewable Heat And Power From Non-Woody Biomass

Jing Fu, Artur Pozarlik, Amir Mahmoudi, Huub Ratering
University of Twente; HoST

Reconstruction of downstream acoustics from two separate SISO measurements of flame

Hamed F. Ganji, Viktor Kornilov, Jeroen van Oijen, Ines Lopez Arteaga
Eindhoven University of Technology

Analysis of combusted iron powder using X-ray computed tomography

Conrad Hessels, Giulia Finotello, Xiaocheng Mi, Roy Hermanns, Philip de Goey
Eindhoven University of Technology

Experimental and Numerical Investigation of a diffusion burner with CO₂ Dilute Oxy-Combustion of Natural Gas and Hydrogen

Nicolas Jouret
KU Leuven

Effect of ammonia blending in strained lean premixed hydrogen flamelets

Ribhav Khanduja, Alessandro Porcarelli, Ivan Langella
Delft University of Technology

AmmoniaDrive: Ignition Delay Time and Burning Velocity of Ammonia/Anode-Off-Gas mixtures

MohammadReza Kohansal, Rob Bastiaans, Anatoli Mokhov
University of Groningen; Eindhoven University of Technology

Non-catalytic methane steam reforming

Yang Li, Aravind Purushothaman Vellayani, Anatoli V. Mokhov
University of Groningen

Modeling on the flame propagation characteristics of ammonia/hydrogen/air mixtures

Xin Liu, Rob Bastiaans
Eindhoven University of Technology

Super (critical) Combustion

Sylwia Oles
University of Twente

Mixing characterization of high-pressure H₂ jets using LIF and Rayleigh scattering

Max Peters, Noud Maes, Nico Dam, Hugo Quintens, Michele Bardi, Jeroen van Oijen
Eindhoven University of Technology; IFPEN

Reduce Carbon and NO_x Emissions while Increasing Heater Profitability with New Technology

Erwin Platvoet
XRG Technologies LLC, USA

Characterising the Burning Velocity of Iron Powder using a V-shaped Burner

Helen Prime, Yuriy Shoshyn, Roy Hermanns, Philip de Goey
Eindhoven University of Technology

Characterization of iron particle temperatures in a 200kW boiler system

Niek van Rooij, Yuriy Shoshyn, Philip de Goey
Eindhoven University of Technology

Lean Blow-off behavior of flames with different Lewis numbers

Tong Su, Nicolas Worth, Boyan Xu, Rob Bastiaans
Eindhoven University of Technology

Design of Experiments optimized combustion and emissions for OME-diesel blends

Zhongcheng Sun, Harold van Beers, Michel Cuijpers, Bart Somers, Noud Maes
Eindhoven University of Technology

To probe the internal structure and composition of burning iron particles via interceptive quenching

Wenjiang Tian, Muhammed Abdallah, Jesse Hameete, Yuriy Shoshin, XiaoCheng Mi
Eindhoven University of Technology

An experimental study on fire propagation characteristics of lithium iron phosphate batteries

Wang Qinzhen, Huaibin Wang, Chengshan Xu, Changyong Jin, Xuning Feng
Beijing Institute of Technology; Tsinghua University; Chinese People's Police University; University of Shanghai for Science and Technology

CFD studies of ammonia/hydrogen flames in gas turbines

Shuzhan Wang, Krtin Kala, Xin Liu, Rob Bastiaans
Eindhoven University of Technology