Waterstof als brandstof voor industriële verhitting

Publieke samenvatting / Public summary

Aanleiding

The challenge for the transition of direct and indirect heating processes to a carbon-free, hydrogen-fueled, future is to maintain (or improve) product quality, optimize efficiency and to keep the NOx emissions within the prescribed limits for the range of fuel compositions encountered in the transition: from natural gas to pure hydrogen. To meet the challenge, tailoring heat transfer (including footprint), composition of the kiln atmosphere and NOx mitigating strategies, for the different product classes, all with a well-functioning burner system, must be achieved. As there is hardly any experimental data on all these aspects, applied research is necessary to facilitate this transition. At present, no retrofit burner technology is available that can handle the combustion of varying natural gas/hydrogen mixtures (0-100% hydrogen) while maintaining efficiency and low NOx emissions. Additionally, for processes that need high temperature (e.g. melting glass) oxyfuel is necessary to prevent unacceptable high NOx emissions.

Doelstelling

DNV GL launches this project to contribute to the reduction of CO2 emission in the industry by introducing hydrogen as a fuel for direct- and indirect heating processes without compromising process efficiency and product quality. To guarantee uninterrupted plant operation for periods with varying hydrogen supply, hydrogen and hydrogen/natural gas mixtures as fuel for heating process fuel an adaptive burner control systems will be developed in this project for direct- and indirect

Projectinformatie / Project information

Projectnummer / Project number
TWAS119016
Subsidiebedrag / Grant amount
€ 277.891,00

Algemene informatie / General information

Penvoerder / Secretariat
DNV GL Netherlands B.V.

Publicaties en materialen / Publications and attachments

- **28.11.2023**

  Eindrapport TWAS119016

Volg Topsector Energie op X / Follow Topsector Energie on X

@TSEnergie

heating processes. Furthermore the goal is the address the changes in the combustion properties, heat transfer, kiln atmosphere and emissions by performing experiments and 3-D CFD modelling to guarantee optimal combustion and product quality when introducing hydrogen as a fuel. The validated CFD model will provide new design rules for oven designers for next generation high temperature kilns and to optimize current heating processes when using hydrogen as a fuel. Additionally, for indirect heating processes the goal is to develop and demonstrate a new novel burner technology for steam production by using hydrogen/oxidizer/water vapor mixtures.

Korte omschrijving

In this project three industrial burner types for the high temperature processes and one burner for low temperature processes will be selected together with the project partners and tested in the industrial high temperature kiln and industrial boiler in the combustion laboratory of DNV GL. To guarantee safe and optimal combustion performance the selected burners will be equipped with a fuel adaptive burner control system that uses a combustion algorithm to maintain optimal combustion when hydrogen is added to natural gas. To mitigate the NOx emission when adding hydrogen to natural gas, NOx control strategies will be applied and tested using varying natural gas/hydrogen fuel blends (0-100% H2). Furthermore, for direct heating processes the use of hydrogen fuel with pure oxygen as oxidizer will be examined using a the selected industrial burners. In this part the use of an in-situ CO, O2, H2O laser sensor developed by CelSian for controlling the oxygen-gas mixture ratio to the burners will be tested. For indirect heating, a new novel burner concept from Stork Thermeq will be tested and further developed together with DNV-GL.

Resultaat

The novel fuel flexible burner control system that will be developed in this study allows optimal combustion (high efficiency and low emissions) in existing commercial available industrial burners

(retrofit) for natural gas/hydrogen (0-100% hydrogen) mixtures. This system proposed here has the advantage that existing processes, which currently use hot combustion gases, do not have to be drastically adjusted and allows fuel flexibility (0-100% H2). The control system developed here can be directly implemented to allow large scale pilot projects on site of factories for using hydrogen or blending to natural gas as a fuel for heating processes. Furthermore, the CFD modeling and experimental results obtained in this study will give insights in the changes of the flame length, heat transfer to the load, the oven atmosphere and emissions when switching from natural gas to hydrogen These insights are essential to guarantee and/or optimize product quality in direct heating processes and to define new research, pilot projects and new design rules for next generation ovens/boilers and kilns when using hydrogen as a fuel.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
Voor meer informatie over de Topsector Energie, ga naar **www.topsectorenergie.nl**.

Voor meer informatie over de TSE / Energie-Innovatie regelingen die RVO aanbiedt, ga naar **www.rvo.nl/tse**.