

# MSc thesis – Combustion in 3D printed device

## Background

In the last 50 years the composition of natural gas in the Dutch gas grid was very constant. It is expected that the gas quality bands are going to vary much more due to changes of the main gas supply streams, i.e. the introduction of biogas in the gas grid will also lead to broadening of the gas quality bands. Although the used volume of biogas is relatively low, it can cause variation because the gas quality of biogas varies periodically. This can cause a shift in the currently existing paradigm of paying per cubic meter of gas ( $\text{€}/\text{m}^3$ ) to paying per mega Joule of heat generated per cubic meter of gas ( $\text{€}/\text{MJ}/\text{m}^3$ ).

## Project

The project, of which you become a part, aims at the realization of a miniaturized Wobbe index meter for the measurement of the energy content of fuel gases. Fuel gas and air are mixed and heated up to ignition temperature, resulting in spontaneous combustion:



The combustion energy is estimated from the resulting elevation in temperature and, combined with density and flow rates measured by integrated micro Coriolis mass flow sensors, the Wobbe index can be calculated. One of the possible directions is a device 3D printed in ceramic material ( $\text{Al}_2\text{O}_3$ ). This device can replace existing bulky and expensive Wobbe index meters and enables gas monitoring at the central heating system of the consumer's home.



Your MSc thesis is all about designing and testing such a device. Examples of things that need to be taken into account are optimal mixing strategies, implementation of heaters and sensors, heat transfer through the device and analysis of combustion products. When time allows, there is also the possibility to look into catalytic combustion and methods how to combine this with the 3D printed device.

Your project will be performed in the Micro Sensors and Systems group of the faculty EWI/EEMCS:

<https://www.utwente.nl/ewi/mss/>

You will work closely together with your daily supervisor and one other PhD student, who are both working on the STW project "Integrated Wobbe Index Meter".

## Tasks

Summarized, your assignment consists of the following tasks:

- Literature study on micro/mini scale combustion;
- Modelling different geometries for mixing and heating;
- Designing a 3D printed Wobbe index meter;
- Investigate how to print such a device in ceramic material (together with a company, since we don't have the experience);
- Performing combustion experiments in this 3D printed device;
- Measuring the combustion products via a suitable method;
- Analyzing data and proposing relationships between flow, temperature, combustion products, etc.

And when time and one's background allows:

- Literature study on combustion catalysts;
- Applying a catalyst in the 3D printed device and measuring the formed (catalytic) combustion products.

## Profile

Are you a master student with a mechanical engineering, chemical engineering and/or physics background and currently looking for a MSc thesis topic, then maybe this is a suitable topic for you.

## Contact information

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