Institut für Industrieofenbau und Wärmetechnik

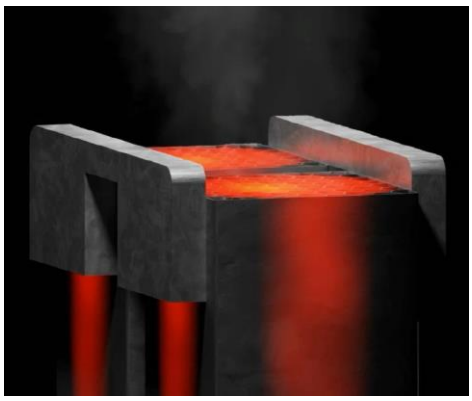
RWTH AACHEN UNIVERSITY

Master Thesis

Numerical investigation of honeycomb heating elements for the heating of process gas

For economic reasons, industrial furnaces are currently mainly heated by burning natural gas. This process produces CO_2 and other climate-damaging gases, which are inevitably emitted into the atmosphere. With a planned reduction of 55% in greenhouse gas emissions in 2030 compared to 1990, the conversion of gas-fired heat treatment plants to alternative heating methods is unavoidable in the long term. Added to this is the pressure on industry resulting from increased primary energy costs and a prospective reduction in dependency on the fossil energy market. Changing the heating technology to electric heating is one solution to reduce the overall CO_2 emissions of industrial facilities. It is assumed that the electricity required for this will come entirely from renewable sources by 2050.

Electric heating can be implemented into an industrial furnace by the use of electric resistance heaters. There are many options regarding operating principle, geometry and available power. A farely new option is the HoneyComb heating element by Sintex used for the heating of process gases. These heating elements are based on metal powder extrusion using high-temperature alloys. Gas flows through the internal structures of the heating element and can reach temperatures of up to 1.100 °C by the element's internal resistance.



The aim of this work is to investigate the heating elements with regard to heat transfer and fluid flow. Therefore, a numerical model is to be developed which should provide insights into

- the local and integral heat transfer coefficients,
- local temperature distribution of the heating elements and gas,
- and the pressure drop caused by the heating element.

This model will then be validated using data provided by Sintex. It will be used to carry out a study to determine the optimum operating points of the heaters for a set of boundary conditions including the heating of different gases (air, hydrogen).

A visit to the Sintex company in Denmark will build up and deepen understanding of the heating element and provide the measurement results needed to validate the numerical model. Familiarization with the software required for numerical modelling is planned

Requirements:

- Knowledge of heat transfer and flow
- Interest in numerical modelling
- Very good knowledge of German and English
- Independent work

Duration: 6 Month

Start: possible as of now

Questions and more information:

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