(632) - (*) - EXPERIMENTAL AND NUMERICAL INVESTIGATION OF MULTI-STAGE FLAMELESS OXIDATION FOR THE COMBUSTION OF ALTERNATIVE FUELS

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The use of renewable and low-carbon fuels is a key contributor to the achievement of the EU greenhouse gas emissions reduction targets for the European industry in the future decades.

Flameless Oxidation (FLOX®), as a technology enabling low thermal NOx formation and high energy efficiency plays an important role in this context. This technology is state of the art for high temperature processes taking place at temperatures, e.g. the furnace temperature, above the self-ignition temperature of the fuel-air mixture. In practical applications, the threshold temperature is commonly set at 850°C. In order to extend the applicability of flameless oxidation to processes at temperatures lower than this threshold and to account for the utilization of alternative fuels, including nitrogen containing fuels such as ammonia, the combustion process is subdivided into multiple stages.

The experimental investigation of individual stages as well as a demonstration of the complete process of the multi-stage flameless oxidation takes place in the test laboratory of the company WS and at IOB, the Department for Industrial Furnaces and Heat Engineering of the RWTH Aachen, as part of a research project funded by the German Federal Ministry for Economic Affairs and Energy.
For the investigation of the first stage of combustion, a cylindrical combustion chamber is electrically heated to a defined temperature. The electrical power is used to compensate for wall losses at the selected temperature. Under these conditions, flameless combustion in an almost adiabatic combustion chamber can be investigated at under-stoichiometric and over-stoichiometric conditions.
The investigation of the full multi-stage flameless oxidation in the power range of 10 to 100 kW takes place in an additional test facility. The aim of the investigations is to determine the influences of variables such as power, air ratio, nozzle geometry and fuel composition on temperature distribution, exhaust gas composition and pollutant emissions. The current experimental results are compared with CFD calculations from simplified numerical models and presented in this article.

Palavras-chave : FLOX, NOx, Alternative Fuels