TECHNISCHE UNIVERSITÄT WIEN

INSTITUTE OF CHEMICAL, ENVIRONMENTAL & BIOSCIENCE ENGINEERING

Univ.Prof. Dipl.-Ing. Dr. Franz WINTER
GETREIDEMARKT 9/166
A-1060 WIEN
Austria
TEL. +43 1/588 01-166301
FAX. +43 1/588 01-16699
Email: franz.winter@tuwien.ac.at

17. 05. 2023

Evaluation

of the Doctoral Thesis

Formation of NO_x in oxy-fuel combustion in a bubbling fluidized bed

by Ing. Matej Vodicka

The Doctoral Thesis of Ing. Matej Vodicka is focused on understanding NO_x formation in oxy-fuel combustion in bubbling fluidized beds.

Oxy-fuel combustion is a promising method to obtain a very CO_2 – rich flue gas which can be quite easily used or stored because it is not diluted with high amounts of nitrogen in contrast to air combustion. Furthermore retrofitting of existing air combustion units is possible. However beside the advantage of a highly concentrated CO_2 gas flow, NO_x formation may be an important issue due to the nature of the nitrogen in the fuel. NO_x formation may be significant especially in oxygen – rich environments. This was the major issue of this thesis.

Ing. Matej Vodicka studied two different fuels which represent their classes. Experimental work was done with a Czech lignite and spruce wood pellets in two different fluidized bed combustors. One in the range of 30 kW thermal and a larger one in the range of 500 kW thermal.

In detail the effects of the oxygen stoichiometry, the fluidized bed temperature and the staged supply of oxygen on NO_x formation were investigated, also obtaining the speciation of nitrogen as NO_x, NO_2 and N_2O.

It was found that NO_x formation is highly sensitive to the oxygen stoichiometry for both fuels. However the fluidized bed temperature effect was only found in the case of lignite combustion where NO_x increased with increasing

temperature. With a staged supply of oxygen a significant NO_x reduction could be achieved.

In addition to the experimental work accompanying modeling work was performed using 4 different kinetic mechanism and compared their performance. A 1-D plug flow reactor model was applied to obtain the progress of homogeneous gas-phase chemistry. Finally, a good agreement of the experimental and the modeling results were obtained in most of the cases.

Ing. Matej Vodicka's thesis is well structured and organized, and written in English language. It consists of 8 major chapters and is written as monograph with more than 160 pages including the Appendix.

One chapter of the thesis gives an overview of the excellent number of publications of Ing. Matej Vodicka (15 in total) which have been published in high-ranking international journals like Journal of Cleaner Production and Fuel and international and national conferences and even in a book chapter. Ing. Vodicka was 6 times first author and 9 times co-author.

Generally the thesis and the publications are demonstrating the research topic of Ing. Matej Vodicka and they show very well his significant contributions to the research field.

The aims of the doctoral thesis of Ing. Matej Vodicka have been fully achieved. It is a very good thesis and evaluates the very complex processes of NO_x formation in oxy-fuel combustion in bubbling fluidized bed in detail.

Therefore I recommend this Doctoral Thesis for its final defense presentation

Univ.Prof. Dipl.-Ing. Dr. Franz Winter