Opponent´s report of the PhD Thesis processed by Ing. Najdat SALAMI

Opponent: Assoc. Prof. Ladislav Bébar, Ph.D.

THEME GASIFICATION OF PINE WOOD CHIPS WITH AIR-STEAM IN FLUIDIZED BED

Date 3th February 2015

The opponent’s report was written upon appointment 8/13903/15/Vrb by the Dean of Faculty of Mechanical Engineering, Brno University of Technology on 12th January 2015.

PhD thesis (Thesis) of Ing. Najdat Salami deals with the problem of gasification of pine wood chips in fluidized bed reactor, formerly with studying the effect of using of air-steam mixture as gasification agent on produced gas properties.

Topic of the Thesis

The topic of Thesis is well chosen as the exploitation of renewable energy sources, mostly of biomass, currently belongs to principal issues. The main focus of the Thesis is in harmony with research and development of author’s supervising working place – Institute of Power Engineering of Brno University of Technology.

One of the most important problems of energetic utilization of gas, which has been produced by gasification of biomass, is a creation of a whole spectra of organic substances including high-molecular substances such as tar. These substances, however, condense during cooling of the gas product and thus cause problems in gas transfer lines and also in equipment designed for final energetic and chemical utilization of these products.

The presented Thesis focuses on the issues of possible lowering of production of unwanted tar products and coke sediments during the biomass gasification process with added steam. This assumption is legitimate and the goal of this Thesis was to confirm the said assumption experimentally.

Results of the Thesis

According to the results of the experiments and discussion, it has been found out that by using the mixture of steam and air the quality of gas will improve. On the basis of experiments, technological parameters of biomass gasification that improve the quality of the produced gas were defined. This Thesis will surely become a valuable piece in the mosaic of biomass gasification issues dealt with at the Institute of Power Engineering of BUT. From this point of view I can submit that the main intention of Thesis was fulfilled.
Overall content of PhD Thesis

The submitted PhD Thesis consists of total 110 pages, from that the text part represents 95 pages. The Thesis is based on author’s publications and refers to 60 literature sources. Mr. Najdat Salami is author of 5 technical publications and contributions, from that one was presented on the International Congress of Chemical and Process Engineering CHISA 2014 and one publication was presented in the All Baath University Magazine in Syria.

In chapters 1 to 9 the author describes on 30 pages the process of biomass gasification, typical technological conditions, yields and properties of the products. In this part of Thesis, common knowledge about the process is referred. Chapter 10 describes experimental equipment BIOFLUID 100 installed on the Institute of Power Engineering.

Chapter 11 contains a description of the methods of measurements of main technological parameters during the experiments and methods of the evaluation of the results and samples analysis. Paragraph 11.4.2 describes the apparatus and conditions of the experiments. Evaluation of the experiment is included in chapter 12 on 35 pages. Author resumes his conclusions on 4 pages in the final part of thesis without denotation of this paragraph.

Main comments to the thesis of Mr. Najdat Salami.

From the description of experimental work it seems that the author relies only on one experiment. On the pages 50 and 51 the author states the duration of the experiment in interval 10:00 to 15:35 without stating the date. On the other hand, the author states in the Abstract that “many experiments have been performed”. Thus, I am asking the author to explain the situation. If there more experiments were performed I ask the author to present the evidence. If the conclusions are based only on one experiment with duration 5,5 hours, I cannot accept the exhaustive statement of the author in the “Conclusion” and in the “Abstract” that the optimal area of operating conditions was found with declared accuracy (specifically temperature = 829 °C, steam/biomass ratio = 0,69 kg/kg, steam/air ratio = 0,57 kg/kg and stoichiometric ratio = 0,29). I also miss information about verification of reproducibility of experimental results what composition of the product gas at different technological parameters concerns. I miss any mathematical model for supporting the declared conclusion of favourable influence on the gasification process of biomass with the air-steam mixture.

Formal Remarks

The Thesis is written in English language. Nevertheless in Thesis and also in “Summary of Doctoral Thesis” there are many incorrect expressions, which I don’t mention in detail but it is necessary to repair namely before publication of Summary of Thesis.

What technical questions concerns, it is not possible to write the format of units of heat as [Kj]. If the volume of the gas is expressed under normal conditions, it is necessary to indicate it, e.g. [mN³]. In the Table 1 (page 16) author declares the heat of some reactions occurring in gasification as “ΔH₀¹”. I am sure that author knows that the absolute values of the “reaction enthalpy change” and “heat of reaction” are identical but these quantities have opposite signs.
Quotations to the referred literature sources are not always in accordance with BUT standards. The author also states several references of domestic literature and conferences. Given that the Thesis is written in English, their titles should be expressed also in English. The reference of the author’s contribution in Al Baath University Magazine is not complete.

The same suggestions applies also for Summary of Doctoral Thesis

**Question for defence**

1) In the paragraph 11.4.2 there is describing only one experiment of gasification the pine wood chips with air and steam. I am interested if author has performed more experiments of gasification. In the positive case I please author to present it or to comment which data he has used to make declared conclusions.

2) I would ask the author to comment a summary opinion and reasoning of the optimal operating conditions of the biomass gasification process mainly on the basis of the author’s own research work.

3) Can author discuss the subsequent exploitation of produced gas from the process of biomass gasification in the way of energetic or chemical utilization?

**Conclusion**

In spite of the above stated comments, I support awarding the Ph.D. thesis of Ing. N. Salami expecting the explanation of the main remarks.
In case of a successful defence, I recommend awarding Ing. N. Salami the title Ph.D.

In Brno, 3\textsuperscript{th} February 2015

Assoc. Prof. Ladislav Bébar, Ph.D.
Institute of Process and Environmental Engineering
Faculty of Mechanical Engineering
Brno University of Technology