

## I. IDENTIFICATION DATA

<b>Thesis title:</b>	Waste gasification – a techno-economic study (Technicko-ekonomická studie technologie gasifikace odpadu)
<b>Author's name:</b>	Martin Pekař
<b>Type of thesis :</b>	master
<b>Faculty/Institute:</b>	Faculty of Mechanical Engineering (FME)
<b>Department:</b>	Department of Process Engineering
<b>Thesis reviewer:</b>	Dr Radosław Ślęzak
<b>Reviewer's department:</b>	Lodz University of Technology, Faculty of Process and Environmental Engineering, Department of Bioprocess Engineering

## II. EVALUATION OF INDIVIDUAL CRITERIA

<b>Assignment</b> <i>How demanding was the assigned project?</i>	<b>challenging</b>
In the work technological and economical aspect of gasification process is described and analysed. The work is divided into two parts: 1st part contains actual knowledge about biomass and gasification process. In the second part of the thesis the Author carried out technical and economical calculation and sensitive analysis of the biomass gasification process in fluidized bed reactor using vapour and air as a gasifying agent. Calculated mass, energy and especially economic balance is adequate for a master's degree thesis.	

<b>Fulfilment of assignment</b> <i>How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.</i>	<b>fulfilled</b>
The final work fulfills the thesis's requirements. All tasks of the work were successfully solved.	

<b>Methodology</b> <i>Comment on the correctness of the approach and/or the solution methods.</i>	<b>correct</b>
The author chose correctly process and methods to solve problem in the work. The selected methods are used in appropriate way.	

<b>Technical level</b> <i>Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?</i>	<b>B - very good.</b>
The expertise level of the thesis is very good. The Author has a wide knowledge gained from the study of scientific literature and industry. During solving engineering problems the author proved high abilities and skills.	

<b>Formal and language level, scope of thesis</b> <i>Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?</i>	<b>B - very good.</b>
The thesis was written correctly. The style of writing is coherent. All chapters were presented in a concise and easy understandable form. The overall graphical level of work is very good. Some tables (for example table 31) could be better edited. In my opinion PFD scheme should not be added as a separate file in the electronic attachment but included to the work content. Some abbreviations are not explained in text for example IRR (table 61).	

**Selection of sources, citation correctness****A - excellent.**

*Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?*

*Author used 37 relevant references in the work, in which 3 of them were in English and 1 in German. This literature is correctly chosen to receive information about gasification process and data from industry. Received data by Author corresponds to information from literature.*

**Additional commentary and evaluation (optional)**

*Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.*

The Author presents comprehensive analysis of economical aspect of gasification process. The most valuable part of the work is Chapter 7 in which Author presented critical discussions about profitability of syngas production for industry. Additionally, in the mentioned part of the work the description of cost raw materials and produced gasses is regarded as very significant.

### III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

*Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.*

The thesis describing gasification process of wood pellets contains 108 pages of text, 17 pictures, 12 figures, 68 tables and 6 appendices in the electronic form. The first part of the thesis the Author presents kinds and potential of biomass and biofuels produced from biomass. In the following part of thesis described gasification process (reactions, type of gasifier and gasifying agent) and methods of syngas utilisation. The first part of thesis is created using actual literature. Based on the literature review the Author proposed fluidized bed reactor for gasification of wooden pellets using vapour and air as gasifying agent. The second part of thesis doesn't contain experiments and all input data was taken from literature review. In this part mass, energy and especially economic balances for two cases were made. In the first case gasifying agent was air and in the second one- vapour. Based on the results the Author defined profitability and payback time of the biomass gasification process. The Author precisely compared gasification using air and vapour as a gasifying agent. In the final part of thesis the Author presented reflection on the overall technology and sensitivity analysis.

The received results of the thesis are useful for estimation of economical aspect of gasification process of biomass. The author has extensive knowledge to solve engineering problems.

I recommend the presented diploma thesis for the defence.

**Comments to the work:**

- Assumption that heat of gasification process is the same for using air or vapour as gasifying agent is not precise.
- Page 49, Water content in wood pellets has impact on energy balance.
- Page 50, In heat exchanger (W-141) we can recover heat.
- Page 54, Selection of the fan depends not only on the flow but also on pressure drop.
- Page 60, Gas from gasification process is significantly less calorific than natural gas.
- Page 62, The unit of electricity in table 29 should refer to time (kWh).

- Page 74, A kind of condenser should be described during steam gasification.
- Page 77, The composition of syngas during gasification of wood pellets is different when we used air or vapour as a gasifying agent.

Questions for thesis defence:

1. Why is thermochemical process better than biochemical one? What kinds of biomass properties should be characterised for gasification process?
2. What types of gasifiers are recommended for biomass gasification and why?
3. Which factor (air or vapor as a gasifying agent) will have influence on heat of reaction?
4. Why is the production of H<sub>2</sub> and CO higher during steam gasification than air gasification?
5. What is the most important factor for development of gasification unit in Czech Republic?

The above comments and questions do not reduce the quality of the presented work. Due to professional level and the high quality of the submitted diploma thesis .

The grade that I award for the thesis is **B - very good**.

Date: 27.1.2020

Signature:

*Radosław Świątek*

