

I. IDENTIFICATION DATA

Title:	BALANCE OF HYDROGEN PRODUCTION TECHNOLOGY USING GASIFICATION OF WOOD CHIPS
Author:	Nikita Kozlov
Type of thesis:	Master Thesis
Faculty/department:	Czech Technical University in Prague, Faculty of Mechanical Engineering
Department:	Department of Process Engineering
Reviewer:	Prof. Ireneusz Zbicinski
Reviewer's place of employment:	Lodz University of Technology, Faculty of Process and Environmental Engineering

II. EVALUATION CRITERIONS

Thesis assignment	Average
<i>Difficulty evaluation of the thesis assignment.</i>	
<p>In the work technology for hydrogen production from wooden pellets (made from waste wood) is described and analysed. The work contains current state-of-art of technologies to produce hydrogen like: steam reforming (the most common method to produce hydrogen), electrolysis, alkaline electrolysers, PEM electrolysis, etc. In the main part of the thesis the Author carried out technical and economic calculations, sensitivity analysis and risk assessment of the Dual Fluidized Bed Reactor system for hydrogen production. The topic of the presented thesis is a typical engineering task for a mechanical or chemical engineers. I estimate the difficulty of the thesis assignment as average and adequate for a master's degree graduate.</p>	

Fulfilment of the thesis's assignment	Fulfilled
<i>Evaluate whether the proposed final work satisfies the assignment. Comments where appropriate, points of reference that were not fully met, or if the work is extended compared to the task. If the task is also not wholly fulfilled, try to assess the importance, impact and possibly cause various deficiencies.</i>	
<p>In my opinion the final work fully satisfies the assignment; the aim of the work was completed, all engineering tasks were successfully finished.</p>	

The chosen solution to the procedure	B - very good
<i>Evaluate whether the student chose the correct process or method of solution.</i>	
<p>The Author selected correct approach to solve the problem established in the thesis. I have no objections to the solution procedures and methodology applied.</p>	

Professional level	B - very good
<i>Assess the expertise level of the thesis, using the knowledge gained from the study of scientific literature, documentation and utilisation of data obtained from the practice.</i>	
<p>The expertise level of the thesis, utilization of literature data and engineering calculations were performed according to the state of the art rules. The author has proved ability and showed skills to solve engineering problems.</p>	

Formal and language level	B - very good
<i>Assess formal correctness in the bibliography, the typographical and linguistic aspects of the thesis.</i>	
All the formal requirements are fulfilled in the thesis. Clear style of writing, systematic organization of the content, logical structure of the chapters. Very good graphical level.	
Some objections to the English language, awkward expressions, overusing of phrases not appropriate for engineering thesis. Some remarks detailed in comments below.	

Bibliography	A - excellent
<i>Comment the student's activity during the acquisition and use of learning materials to solve the thesis. Characterise the selection of sources. Assess whether the student made use of all relevant sources. Verify that adopted information is correctly distinguished from student's results and considerations, whether citation forms correspond with ethics, whether bibliographic citations are complete and finally whether all citation is by the practices and standards.</i>	
The Author analysed 44 relevant references in the text of the thesis. Citations in the text, format of the citations in the bibliography meet standards of the European Copyright Act No. 1,21/2000.	
Information from literature sources corresponds to the results and considerations.	

Other comments
<i>Comment the level achieved significant results of the final work, e.g. the level of theoretical results, or the functional level of technical solutions, publication outlets, experimental skills, etc.</i>
The Author has proved skills to solve engineering problems. Mr. Kozlov did not make any experiments but properly utilized literature data to solve engineering task. The Author showed openings, benefits and drawbacks of DFB technology in application to wood waste gasification. In my opinion the level of the thesis is good.

III. FINAL EVALUATION, TASK FOR THESIS DEFENCE, PROPOSAL OF CLASSIFICATION

Summarise aspects of the thesis that most influenced your final evaluation.

The thesis which contains 72 pages of text, 29 figures, 31 tables and 2 appendices focuses on DFB, the emerging technology for producing hydrogen from wooden pellets which should replace the most common technology now; steam reforming. The introduction part of the thesis was focused on literature survey on the methods to produce hydrogen: steam reforming, electrolysis, alkaline electrolysis, PEM electrolysis, etc. In the main, practical part of this thesis the Author applied theory from literature survey to find a modern, energy and ecologically efficient way to produce hydrogen. Finally, the Author proposed DFB System and membranes as potential technology for producing hydrogen with high efficiency. In the practical part of the thesis, on the basis of literature data (no experiments have been done within the work) the Author elaborated mass and energy balances of the DFB technology, estimated investment cost, profits, operating costs, evaluated payback period. The Author claim that the DGFB technology will be economic if price of hydrogen is around 5 USD/kg. In the next step, sensitivity analysis as well as process risk assessment of Dual Fluidized Bed Reactor system were carried out. The Author developed the block diagram (3 blocks) for DFB technology and elaborated PFD charts (Annex 2) showing the designed plant concept.

The results of the thesis are valuable, promising and could be very useful for other future works.

I appreciate high standard of submitted work. The author has clearly demonstrated the ability to solve engineering problems. I recommend the presented diploma thesis for the defense.

Comments to the work:

Many awkward English expressions; e.g.

In technological texts avoid using word “to create”, much better word is “to develop”

- Page 10 The lignocellulosic waste is presented in the agriculture....
- Page 12 ...show that recirculation used a lot.
- Page 18 Mainly the remaining technologies....
- Page 23 There has been a serious amount of research...
- Page 37 Due to everything being bound....
- Page 31 It is apparent....
- Chronological order of the citations is disrupted in the Chapter 2, citations start with no. [35].
- Page 60 Conclusions (not Conclusion!) are vogue, findings from technological, economic and risk analysis carried out in the work should be shown

Questions for thesis defense:

- All balances were calculated for 1000 kg/h of biomass gasified; how the final outcome will be changed regarding economic aspects for one magnitude higher amount of biomass gasified?
- What is the current unit price of hydrogen? As I know is much higher than 5 USD/kg. Do we have guarantee that DFB system will always be efficient?
- How adiabatic efficiency (70%) of the process was estimated? Does it mean that we assume 30% of losses to the environment? Rather high value.
- What is a base of claim that in the next 5 years DFB System and membranes will achieve pilot plant scale?

The above comments and questions do not reduce the quality of the presented work. Due to the professional level and the high quality of the submitted diploma thesis, I evaluate the work by the grade:

B - very good

Date: 17.6.2019

Signature: 