

I. IDENTIFICATION DATA

Title:	Decentralized hydrogen production technology
Author:	Venkat Subramani
Type of thesis:	master
Faculty/department:	Faculty of Mechanical Engineering
Department:	Department of Process Engineering
Reviewer:	Ing. Jiří Trejbal, PhD.
Reviewer's place of employment:	UCT Prague, Department of Organic Technology

II. EVALUATION CRITERIONS

Thesis assignment	Average
<i>Difficulty evaluation of the thesis assignment.</i>	
<p>The main objective of this thesis is to prepare an overview of hydrogen production technologies. The following goals were declared in master thesis assignment: 1) to perform a critical technical evaluation and assess their potential for usage in a decentralized mode of operation. 2) to process a technical study of suitable hydrogen production technologies. 3) to discuss their potential using sensitivity analysis. I evaluate the assignment of this theses as average due to middle complexity and time that was available for solving</p>	

Fulfilment of the thesis's assignment	Fulfilled with major reservations
<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>The following goals were declared in master thesis assignment: 1) to perform a critical technical evaluation and assess their potential for usage in a decentralized mode of operation. 2) to process a technical study of suitable hydrogen production technologies. 3) to discuss their potential using sensitivity analysis.</p> <p>There is only brief information about hydrogen production technologies in the literature part of thesis. Information like a process setup, PFD schemes, process parameters, energy consumption is missing. More detail information should be presented bearing in mind that there are many available sources of information. List of references shows that the main source of information was public popular web sites and unfortunately only little information comes from technical and scientific literature.</p> <p>Hydrogen production processes are discussed mainly from the point of view economy without deep connection to technical solution in the calculation part of thesis. All economical balances are based on weak technological background and derived values are probably questionable.</p>	

The chosen solution to the procedure	C - good
<i>Evaluate whether the student chose the correct process or method of solution.</i>	
<p>The author chose correct approach to solving of formulated tasks</p>	

Professional level	E - sufficient
<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 author did not pay attention enough to quality of elaboration. The procedures used for calculation of mass and energy balance are not precisely described in the text. The reviewer had to recalculate mass and energy balance to be able to assess presented results. Some data that were used as input data were overtaken without any comment or explanation. According to my opinion process flow diagrams are very weak and process parameters like a temperature and a pressure should be presented.</p> <p>100% efficiency is expected in the electrolyzer. Efficiency is every time lower due to heat loses.</p> <p>Hydrogen compressor has polytropic efficiency 80 % in table 7 but 98 % in table 35. Why?</p> <p>Inlet temperature to the compressor in tables 7 and 35 is 100 °C. Why? Hydrogen is usually cooled to decrease energy consumption.</p>	

In the text is written "compress the hydrogen from 8bar to 30 bars" but in the table 7 there is 30 to 50 bar. Why? PFD of steam reforming is incorrect. Heat exchanger H101 and H102 (exchangers are marked like "E" around the world) are not cooled by water but they are used for a feed preheating. Calculation of a water amount required for a cooling is wrong (tables 32 and 34). It is necessary to define inlet and outlet temperature of cooling water. "Specific enthalpy of water" is not the same like heat capacity of water.

Formal and language level

D - satisfactory

Assess formal correctness in the bibliography, the typographical and linguistic aspects of the thesis.

The thesis contains all the necessary formal requirements. Unfortunately, little effort was devoted to achieve expectable formal level.

- Chemical equations are not numbered (page 14, 17 etc.)
- Equation at the page 14 describes an equilibrium reaction. Two arrows should be used instead of one double arrow.
- Equation at page 32 should be corrected (indexes, arrows)
- Units on the axis are missing in the all graphs.
- Part of tables are marked like "figure" instead of "table"

Bibliography

E - sufficient

Comment the student's activity during the acquisition and use of learning materials to solve the thesis. Characterize 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.

The selection of sources is nearly insufficient. Deep and critical review based on a technical and scientific literature was not done and used sources don't cover overall range of the thesis.

Other comments

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.

No comments

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

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

I would like to discuss following topics during defense discussion:

- Why the Excel was used instead of some engineering tool like Aspen, HYSYS or ChemCad? Mass and heat balance is easier to do even without mistakes.
- Decentralized production means using of a small units. What is your estimation of minimum capacity of steam reforming process from the point of view realizability.
- Could you estimate based on your literature study in which technology is still a free area for technical and economic improvement of process in the future.

The thesis submitted fulfils the requirements for the master thesis. The goals declared were satisfied with major reservation. I recommend the master thesis submitted by Mr. Venkat Subramani to the defense. Owing to the level of technical and formal quality I evaluate handed thesis with classification grade

E - sufficient

Date: 7.8.2019

Signature: Ing. Jiří Trejbal, PhD.

