

## I. IDENTIFICATION DATA

<b>Title:</b>	<b>Waste CO<sub>2</sub> as a raw material to produce methanol</b>
<b>Author:</b>	<b>Farid Ismayilov</b>
<b>Type of the thesis:</b>	Master thesis (diploma thesis)
<b>Faculty/department:</b>	Faculty of Mechanical Engineering
<b>Department:</b>	Department of Process Engineering
<b>Reviewer:</b>	Ing. Jaromír Štancl, Ph.D.
<b>Reviewer's place of employment:</b>	FME CTU in Prague - Department of Process Engineering

## II. CRITERIA EVALUATION

<b>Thesis assignment</b>	<b>Average</b>
<i>Difficuly evaluation of the thesis assignment.</i>	
From my point of view, the topic of the presented thesis is a typical engineering task for an engineer in the field of technology projecting. I see the difficulty of the thesis assignment as average and adequate for a master's degree graduate.	

<b>Fulfilment of thesis's assignment</b>	<b>Fulfilled</b>
<i>Evaluate, whether the proposed final work fulfils the assignment. Comment where appropriate, points of reference that were not fully met, or if the work is extended compared to assignment. If the assignment is also not completely fulfilled, try to assess the importance, impact and possibly cause various deficiencies.</i>	
The task of presented work was to prepare a review that scopes and summarize the current knowledge about waste CO <sub>2</sub> to methanol transformation technology and to perform a techno-economic study of the technology (prepare PFD, fundamental mass and energy balances, economical evaluation).	
All the goals given by master thesis assignment were fulfilled and discussed in individual chapters (although for the first goal it may be somewhat questionable).	

<b>The chosen solution procedure</b>	<b>Correct</b>
<i>Assess whether the student has chosen the correct procedure or method of solution.</i>	
I have no fundamental reservations about the chosen solution procedure. The presented work focuses on processing the waste CO <sub>2</sub> to produce methanol. The literature research is mainly focused on CO <sub>2</sub> emissions + capturing, purification and utilization into methanol, methanol production technology and process parameters and finally market survey of the methanol. Presented literature research should be more deeply focused on used technologies and technological parameters according to the thesis's assignment. In the "practical" part of the presented work, the student has created the PFD of the technology. The student also compiled the mass and energy balances of the technology and economical evaluation of the project.	

<b>Professional level</b>	<b>E – sufficient</b>
<i>Assess the expertise level of thesis, using knowledge gained from the study of scientific literature, documentation and utilization of data obtained from practice.</i>	
The professional level of the presented thesis is very weak. In my opinion, the author of the work has demonstrated the ability to find appropriate and necessary information in available literature. However, in my opinion, the author should more discussed acquired knowledge from literature. The quality of the literature research is very poor. The PFD scheme of the technology was practically completely taken from the cited source, the student made only minor and negligible modifications. Mass balance of the technology is also practically completely taken from same cited source as the PFD (same amount of processed CO <sub>2</sub> , same process parameters, same flowrates). The description of the technology and process is not enough, the way of calculating the mass and energy balances and inputs to the economical evaluation are not very conclusive or not mentioned at all. There are some bigger or smaller errors in the practical part of the presented work. In my opinion, the author of the thesis has barely proved his ability to solve the assigned engineering task in the field of projecting new technology independently.	

<b>Formal and language level</b>	<b>C – good</b>
<i>Assess formal correctness of the thesis and the typographical and linguistic aspects of the thesis.</i>	
The presented thesis contains all the necessary formal requirements. The work is written readily and quite well organized; it is appropriately and logically structured into the chapters. On the other side, its typographic and graphical level is rather weaker. The list of used symbols does not contain all symbols used in the whole work.	
<b>Selection of sources, citation correctness and bibliography</b>	<b>E - sufficient</b>
<i>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 properly distinguished from student's results and considerations, whether citation forms are corresponding with ethics, whether bibliographic citations are complete and finally whether all citation are in accordance with the practices and standards.</i>	
Author used 35 relevant references in the text of his thesis. Citations in the text and their format listed in the bibliography are not in accordance with all the citation practices. However, many citations are missing in some parts of the presented work. It is sometimes so difficult to distinguish the author's own thoughts from information taken from literature. The quality of the literature research is very poor – there are more relevant works to these topics in citation databases.	
<b>Other comments</b>	
<i>Comment the level achieved major 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>	
After reading the work I have a question: What is the author's own contribution to this work? Work as a whole gives the impression that the author had not paid sufficient attention to this work, which is a shame.	

### III. FINAL EVALUATION, QUESTIONS FOR THESIS DEFENSE AND PROPOSAL OF CLASSIFICATION

*Summarize aspects of the thesis that most influenced your final evaluation.*

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Author used 35 relevant references in the text of his thesis. Citations in the text and their format listed in the bibliography are not in accordance with all the citation practices. However, some citations are missing in some parts of the presented work. It is so difficult to distinguish the author's own thoughts from information taken from literature.

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In my opinion, All the goals given by master thesis assignment were fulfilled and discussed in individual chapters (although for the first goal it may be somewhat questionable).

Although I find the presented work to be very poor, the presented work has its benefit mainly in the field of summarisation of the necessary information for projecting this type of technology. On the other side I am not able to distinguish what is the author's own contribution to this work. Work as a whole gives the impression that the

author had not paid sufficient attention to this work. Despite the mentioned problems of the work I recommend the presented diploma thesis for the defense.

## Comments to the work:

- Page 5 – Carbon dioxide is released by the burning of only fossil fuels?
- Page 5 – missing caption to the figure – the caption is on next page!
- Page 10 – carbon dioxide is CO<sub>2</sub> not CO2.
- Page 10 and others – the unit of temperature is degrees of C – it means °C not °C!
- Page 15 – Figure 7 – citation missing
- Page 18 – Figure 8 – the letters in the table are too small for reading
- Page 24 – Table 16 – the unit of temperature is not Celsius but °C!
- Page 24 – Figure 9 - the letters are too small for reading
- Page 34 – Why the table 27 is not mentioned earlier in the chapter of economical evaluation?
- Page 34 – Table 27 – it is better to present the amount of steam in form of necessary heat in units GJ/year or MWh/year then in tons of the steam. The steam parameters (temperature and pressure) of the steam should be mentioned too.
- Page 37 – There are not mentioned all used symbols from the whole work!
- Page 41 – The form of some references is not correct.
- Page 4-16 – missing some citations (source of the information)
- Page 30 – Be careful – [www.alibaba.com](http://www.alibaba.com) is selling second hand devices !

Other minor comments are highlighted in the printed thesis.

## Questions for thesis defense:

- Page 10 – there are used some parameters, like XRD, rGO and STY<sub>MeOH</sub>. These parameters or symbols are not explained in the work or mentioned in the list of symbols. Please explain what these symbols mean or express?
- Please explain in detail your PFD and describe in more details whole process. Demonstrate with using equations the method of calculation of the mass balance. Explain the processes in the individual equipments in the PFD.
- Page 25 – Table 17 – c<sub>p</sub> of the water – are the used values correct? In what state the water is (ice, liquid, steam)?
- Page 32 – please explain table 25. How the revenues from sale was calculated? Why the selling product is orange juice and not methanol? Please explain how the prices of energies were estimated (price of electricity and steam seems to be quite low). Please explain presented cumulative CF in fig. 12. Why is the lifetime of the project directly 12 years (according to the fig. 12)?
- I am missing the summarization of the economical evaluation results - mainly net present value - NPV and internal rate of return IRR (parameters based on discounted cashflow with respecting time value of the money) in the economical evaluation. Please explain and present the results of NPV and IRR.
- Can you indicate at least 3 main things what is Your own contribution to this work?

Due to the quality of the submitted diploma thesis, I evaluate the work by the grade:

**E – sufficient**

Date: 29.8.2018

Signature: Ing. Jaromír Štancl, Ph.D., v. r.