THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Power consumption of impellers at non-standard liquid level in tank**
Author's name:	**Janakiraman Kubendran**
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Process Engineering
Thesis reviewer:	doc. Ing. Jan Skočilas, Ph.D.
Reviewer's department:	Department of Process Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **ordinarily challenging**

How demanding was the assigned project?

Thesis was oriented upon the investigation of the power consumption in the mixing apparatuses with non-standard liquid level. Main goal of the thesis is numerical study of one type of the impeller, one geometry of system with different liquid level and different revolution. Student performed CFD simulation for assigned variants of operation conditions and compare results with experiment. The experiments were provided by supervisor.

Fulfilment of assignment **fulfilled with minor objections**

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.

Main goals of the thesis are to perform literature search with respect to investigated problem (fulfilled), to create numerical model describing carried out experiments (fulfilled with minor objections – missing mesh sensitivity analysis and missing experiments description), to validate numerical model with experiments (fulfilled with minor objections – results postprocessing is at least non-standard) and to discuss obtained results (fulfilled with minor objections – missing discussion of the practical application of the results).

Methodology **partially applicable**

Comment on the correctness of the approach and/or the solution methods.

The literature search focuses on wide range of mixing process aspects, however there are only three articles dealing with thesis topic. Two of them are the contributions of supervisor and the last one didn't provide any practical results for thesis. There is not mesh sensitivity study of numerical simulation. The numerical error cannot be reduced by proper selection of the fine mesh. There is no description of impeller geometry. Description of experiments and estimation of the error (statistics) are absolutely missing (however they were performed by supervisor). There were no comparisons between numerical simulation and results of liquid level shape recording even a commentary.

Technical level **D - satisfactory.**

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?

Technical level of the thesis is sufficient. There are mistakes in equations, CFD description, units and postprocessing.

Formal and language level, scope of thesis **E - sufficient.**

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?

There are lot of typing errors, errors in units and wrong formatting of the text. English is on good level. Some the text in figures is not in English.

Selection of sources, citation correctness **D - satisfactory.**

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?

The literature search focuses on wide range of mixing process aspects, however there are only three articles dealing with thesis topic. Two of them are the contributions of supervisor and the last one didn't provide any practical results for thesis. CFD simulation literature search is mainly focused on the theory and not on the work dealing with the thesis topis. There are no recommendation or results (from literature search) from those CFD simulation can be provided. Some of the references are ancient. Fore reference 23, the publisher and journal data are missing.

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.

There are lot of typing errors mainly in wrong text of units (nm instead of Nm, watts instead of W, N/m^2 instead of Pa etc.). Also some units missing for quantities referenced in symbols. Page 2, eq. (2), there is not Froude number. Name of some impellers are wrong (slit blade). Table 2 has no reference. Figure 25 miss the y axis title. The position of the rotation zone in the vessel is not presented. Omega sign is used for angular velocity as well as for specific rate of turbulence dissipation. The coordinate system of the model missing with respect to geometry (XYZ). There are no boundary conditions mentioned for baffles and vessel bottom. The mesh sensitivity analysis is missing. There is a discrepancy between values of water density and water viscosity in text and in the figure 42. Units for dynamic viscosity is Pa.s. In the figure 42, the chemical sign for air is not O2. From figure 46, it seems that simulation has not converged yet. The figure 54 represents discrete points, therefore it should not be connected with lines. In paragraph 4.4, last sentence in page 48, there should be Power number, not Reynolds number. I disagree with sentence in 49 page, "The numerical results have good agreement with experiment". The error 30 % is too high.

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.

Questions for the thesis defend:

1) Show the geometry and dimensions of the used impeller.
2) Describe the measurements. Methods, equipment, materials. How were the revolution and torque measured? How did you calculate power consumption, Reynolds number and power number?
3) Did you check the direction of the impeller in simulation and how?
4) What represents the mean value in table 5 and why is it defined?
5) What represents the table 6, when the position of the impeller in the vessel was stable?
6) Why the highest difference between value torque of simulation and experiments is at highest revolutions 300 RPM?
7) It seems that simulation overpredicts the experimental results in all revolution conditions. Is it true?
8) Are there any pictures of liquid level from experiments to compare it with simulation?
9) The figure 60 represents the main results of your work. Where aeration of the impeller appeared with respect to revolution and liquid level height?
10) What does the Mean power number mean in the table 8?
11) Please evaluate the experiment results alone. How the power consumption depend on the liquid level with respect to impeller aeration (if this information is available)?

The grade that I award for the thesis is **E - sufficient.**

Date: **20.6.2022**

Signature: v.s. Jan Skočilas