CTU
CZECH TECHNICAL UNIVERSITY IN PRAGUE

THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Sampling train for a portable air-liquid interface exposure chamber**
Author's name:	**Anežka Vimrová**
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis reviewer:	Dr. Petra Pokorná
Reviewer's department:	Institute of Chemical Process Fundamentals of the CAS

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment — **challenging**

How demanding was the assigned project?

The thesis combines theoretical as well as experimental parts including measurement, data treatment and interpretation, and enhanced portable toxicological incubator design. From my point of view, the assigned project was challenging since the successful thesis solution required a combination of several skills from the master candidate.

Fulfilment of assignment — **fulfilled**

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.

There were three thesis goals i) perform experiments for cell in vitro exposure to exhaust gases and other complex mixtures with nanoparticles, ii) analyze the data and calculate losses in rotating disc diluter and membrane humidifier and iii) analyze a more compact setup for portable toxicological incubator. The first goal could be assessed as an ultimate goal and the other two as intermediate goals. The thesis focused on nanoparticle measurements rather than exhaust gases that are of bigger concern in the health studies aiming to assess the impact of diesel engine exhausts to human health.

Question: What do you mean by "other complex mixtures with nanoparticles"?

Methodology — **outstanding**

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

The experimental part follows the theoretical part where the master candidate reviewed the engine emission exhaust topic/issue along with the instrumentation utilized for particle measurements in the experimental part. The experimental part presents two experiments i) experimental setup with the particle generator for particle losses calculation in a membrane humidifier and ii) experimental setup to calculate losses in a rotating disc diluter (RDD) using real emissions produced by a compression ignition (CI) engine. Also, a more compact setup for portable toxicological incubator is introduced. Last but not least. the measurement results are presented and discussed. Therefore, the thesis solution methods are in accordance with the scientific work.

Technical level — **B - very good.**

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?

In the theoretical part the master candidate proved the knowledge of the studied issue and work with the sources (in the theoretical part 40 references out of 47 were used). The experimental part could be improved, for instance, experimental setup – particle number size distribution measurement at particle generator (PG); data treatment – more detailed description of data correction, recalculation and smoothening; constant data presentation; correct data interpretation and more extensive discussion (3 references). Despite some imperfections mainly in the experimental part, the technical sound of the thesis is very good.

Formal and language level, scope of thesis — **A - excellent.**

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?

The thesis is organized in a logical way and of sufficient length. The language of the work is clear and understandable, and written in good English. The thesis fulfil all requirements of the master thesis.

Selection of sources, citation correctness **C - good.**

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 reference list composes of 47 references including instruments manuals, WikiSkripta, Wikipedia and Britannica web pages and e-shop web pages, thus I am lacking more scientific studies. Also, the reference list is not presented in the same format and some of the citations are missing ISBN and publisher, and differ in format (italics), name (full names vs first letter) and name order (first name and family name vs family name and first name). Additionally, the utilized citation form in the text "[number]" is not very suitable for a master thesis, however I do not know, what are the conventions at the CTU.

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.

Please insert your comments here.

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 master candidate proved the ability to work scientifically in the sense of formulating goals, reviewing the studied topic, designing experiment, treating and interpreting data, discussing results and deducing conclusions. The theoretical part is well written. The experimental part could be improved since some of the statements are unclear or ambiguous as data treatment and interpretation and raise questions (some of them are listed below). Additionally, the result discussion could be more extensive referring more studies and the references done more precisely. Despite some imperfections, the thesis fulfils all requirements of the master thesis and I recommend it to the defense.

Questions

Experimental setup

Question 1: How did you perform the SMPS measurement before and after the membrane humidifier with one instrument? Please specify how many scans were done before and after the membrane humidifier for plotted SMPS spectra? Please specify how many experiments were done for each electrode?

Question 2: Have you been able to control the constant concentration and size distribution of the particle produced by the PG? What could cause the unstable emissions of the particles?

Data treatment

Question 1: Have you done the SMPS data conversion on your own or in AIM software?

Comment: The software already includes the correction on detection efficiency mention for instance in the page 32 and 36.

Question 2: Please explain what do you mean by "a model sample"?

Text: *"To plot the concentrations before and after the humidifier a model samples were chosen. By averaging values from these samples, the concentrations can be plotted as a function of the particle diameter. Due to this averaging, concentrations can be plotted as two curves, one for samples before the humidifier and the second one for samples after the humidifier."*

Question 3: Have you done the recalculation of raw data or dN/dlogDp?

Text: "To compare these results to results from SMPS and CPC the concentrations needed to be multiplied by 16, which is the number of channels per decade. The channels were equally distributed from 6.04 nm to 523.3 nm. The EEPS also provides data on total concentration."

Question 4: Which correction mentioned on page 42 have you applied?

Text: *"The line A around 20 nm diameters approximately marks where the CPC most probably switched to photometric mode due to the drop in concentration. Line B around 50 nm approximately marks where the CPC switched back to single particle detection mode due to the slight increase in concentration. To smooth out the curve a correction was made."*

Question 5: Where are the empirical calibration factors 1.4 for Fe in Fig. 35 and 1.5 for C in Fig. 39 for curve smoothening coming from?

Data interpretation

Question 1: Please explain appearance of the bigger particles behind the membrane humidifier presented in Fig. 30 and 40.

Question 2: Can you please describe the mechanism of particle condensation and agglomeration? What happen with the particle concentration after condensation and agglomeration?

Comments:

Page 10: Abbreviation is used before determining it.

"The products of ideal combustion of HC fuel are CO2 and H2O, which make approximately 20 % of exhaust gas [11]. During non-ideal oxidation of H and C from the fuel the products are CO, H2, PM and hydrocarbons (HC)."

Page 20: The instruments measure concentration and aerosol particle size.

"There are multiple instruments available for measuring concentration and size of particles in aerosol."

Str. 31 6.1. Experiment with the particle generator (PG)

In the section 6.1. I am missing a note about the particles size distributions of four utilized materials since it is very crucial information for the subsequent losses determination and result discussion.

Str. 36 7.1. Losses in the membrane humidifier

Due to the different measurement principles of EEPS and SMPS data comparison should be done with caution.

Typos:

Page 16: The NO2 forms at lower temperature regions not CO2.

"The CO2 forms at lower temperature regions (below 1200 K) [28]."

Figure 23: The "E" for SMPS was missing in legend.

"Experimental setup; (A) Body of the PG, (B) Head of the PG, (C) Incubator, (D) EEPS, (D) SMPS, (F) CPC, (G) Membrane humidifier, (H) Hepa-filters,(I) Heat exchangers, (J) Pump, (K)."

Page 32: The CPC from the experimental set up is missing in the text.

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"After that the spark was initiated. Before the inlet to the incubator (C) around 3.3-3.6 lpm flow rate is diverted to online particle monitoring (EEPS (D) or EEPS (D) and SMPS (E))."

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

Date: **17.8.2022**

Signature: