

I. IDENTIFICATION DATA

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| Thesis name: | Effects of operating conditions on the production of brake wear particles |
| Author's name: | Srinath Penumarti |
| Type of thesis : | MASTER'S THESIS |
| Faculty/Institute: | Faculty of Mechanical Engineering |
| Department: | Department of Automotive, Combustion Engine and Railway Engineering |
| Thesis reviewer: | Ing. Martin Pechout, Ph.D. |
| Reviewer's department: | Department of Vehicles and Ground Transport, Czech University of Life Sciences |

II. EVALUATION OF INDIVIDUAL CRITERIA

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| Assignment | Extraordinarily challenging |
| <i>Evaluation of thesis difficulty of assignment.</i> | |
| <p>The thesis subject deals with a novel topic of particulate matter emitted due to brake wear at various conditions. In order to get the data remarkable effort had to be spent on recorded data processing and evaluation. The assignment contains many individual goals so if all of them were achieved, typical thesis significantly exceeding ordinary framework would be done.</p> | |

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| Satisfaction of assignment | Satisfied with some objections |
| <i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i> | |
| <p>There are some parts of assignment which are not fulfilled. Especially at least some comparison of on-line and off-line data (e.g. comparison of total mass worn calculated/sampled using emission instruments and brake part weighted mass decrease) should be done or at least commented why such evaluation has not been done. Another point to be done more completely is evaluation of mass distribution according all size bins which are available. Unfortunately, for the ELPI instrument the evaluated range was practically limited to scale of the EEPS which leads to lose of some information.</p> | |

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| Method of conception | C |
| <i>Assess that student has chosen correct approach or solution methods.</i> | |
| <p>Student has chosen proper primary data processing and evaluation methods. On other hand, mass distribution, total mass worn and particles larger than ca 700 nm were omitted without satisfactory comment. Including such results would gain informative value significantly.</p> <p>In some cases the graphical presentation could be improved in numerous cases:</p> <ul style="list-style-type: none"> - some graphs are practically duplicates, e.g. Figures 6.10 and 6.16 and other pairs (same pattern only multiplied by a constant) - the mean bin diameters should be visible from graphs especially for ELPI size spectra in order to illustrate much lower resolution <p>The obtained data are rather primary result and some more data analysis would be very useful, e.g. at which part of braking event most particles (by both number and count) are released, are the total counts and maximum values from individual events at same conditions comparable.</p> | |

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| Technical level | B |
| <i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i> | |
| <p>In general, the data processing method is well designed (reckons and subtracts instrument noise). The larger particles (than approx 700 nm) are excluded from display and the total mass and its spectral is not present despite the data are available. Second order polynoms are used for approximation of specific number of particles per event as a function of average dissipated power. Unfortunately, for some part of power range significant negative values are obtained (e.g. Fig 6.13). For the comparison purposes the size (and possibly mass) distributions should be placed on one page with same scale (and if possibly into one graph) in order to highlight the differences between the individual braking pads. For the section F size distribution (Fig. 6.3) reports much less particles for Ferodo pads, but according total particles emitted</p> | |

during this section (Fig. 6.2) the size distribution should be at similar levels as ABE and Original. For the section G (rising the pressure of braking fluid) remarkable differences are observable, but only averaged results are presented, so size distributions at lower pressures (and also emission levels) are passed over (the bulk of particles produced can be subject of change with the pressure). At one point (last sentence of paragraph 3.1 is mentioned residence time of the sample 0.75 seconds although another value (50 seconds) is stated in first paragraph chapter 5.4.

Formal and language level, scope of thesis

B

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

Concerning the formal structure addition of Discussion and Suggestion part after the Conclusion is very uncommon. The conclusion part itself contains some short repeated description (two paragraphs) so the space available for real conclusions is reduced. In conclusions is also a statement "The data from ELPI of WLTC could not be presented here as particle production was low for less intense braking events and hence could not be differentiated from noise of the instrument" although no such information is given before.

The language level is appropriate and there are only few grammar and typing errors throughout the thesis.

Selection of sources, citation correctness

B

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

The sources used for thesis creation are correctly chosen (actual and representative) and used according to citation standards. They are used in a well-arranged way to introduce the problematic of particulate matter from road transport and its environmental and health effects. On the other hand, most of the suggested bibliography sources are omitted and description of brake wear phenomena could be described more in detail.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

Bulk of the goals (especially the data processing and basic analysis) was done, but much of the experiments and the instruments offered much more than was actually presented. Concerning the measurement campaign took place in October 2019 so there was plenty of time to be spent on thorough analysis and better results presentation. As a result, I suggest overall **grade C** (slightly better).

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

There is dominating a peak with mean diameter around 10 nm. What is the formation mechanism of such particles?

Could you address at which size most of the mass was worn out for each individual brake pad? If there is no complete data available, please give at least one example covering a wide range of operating conditions and complete available range of particles (up to 10 µm for ELPI).

I evaluate handed thesis with classification **grade C**.

Date: **31.8.2020**

Signature:

