

Opponent Review
on Doctoral Thesis
**Research of Coatings of Hydrodynamically Lubricated Sliding
Bearings for Combustion Engines**
submitted by
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to
Brno University of Technology
Faculty of Chemistry

Sliding bearings should enable easy relative motion of a pair of parts in various mechanisms. Theoretically, relative motion of two interacting surfaces is affected by their tribological properties, i.e. the combination of friction, wear and lubrication. However, in the case of sliding bearings used in combustion engines, a complex combination of requirements has to be taken into account. The surface of such sliding bearings has to be able to resist welding and scoring, embed small hard particles without damaging the counterpart, conform to production geometric inaccuracies and resist to corrosive lubricants, fatigue, wear, seizure, temperature and cavitation. Presented Doctoral Thesis "Research of Coatings of Hydrodynamically Lubricated Sliding Bearings for Combustion Engines" is focused on the thorough analysis of commercially available polymer surface layer for sliding bearings and formulation of material alternative based on polymer matrix and dispersed inorganic particles.

From the formal point of view, the Doctoral Thesis is written in English on 113 pages and contains 106 figures (33 of them are attached in Appendix) and 16 tables. The text flow is smooth and contributes to unambiguous understanding the topic under study. What has to be criticized, on the other hand, is the quality of majority of the figures in printed version. Micrographs suffer by insufficient contrast and often almost black rectangles are manifested. Graphs contain points or curves, which can be frequently hard to separate. The language quality is rather high with a low number of misspellings, typing errors, grammar mistakes and "Globish expressions", although some of them can be found, e.g.:

Page 3, Abstract: ... lubricated **condistions**.

Page 77: ... mechanical **dispargation** was needed. – the expression does not exist in proper English.

The Doctoral Thesis is traditionally organized in theoretical and experimental part. Theoretical part brings a profound view on state of the art in the field of engine sliding bearings, materials and method for their production and coating for tribology improvement. Special attention is paid to the overlays from various polymer matrices and solid lubricants. The reader should appreciate almost perfect organization of the text and sufficient level of context information, which enable to understand the problem without use of additional sources.

Experimental part at the beginning defines the goals of the Doctoral Thesis, then describes the materials used, preparation and applications of paints, methods used for analysis of overlay, substrate, counterpart and oils, and finally discusses the results and defines the conclusions. From the text it is evident, that the extent of the experimental work is outstandingly high and the intention is to describe and explain all the phenomena in complex view of chemistry, physics and surface morphology of sliding bearings. However, at the same time a more pronounced discussion of the results from a number of methods should be expected.

Within the defense, I would appreciate the comments and discussion on following points:

1. Page 72, Figure 56: In the text is said that the FTIR spectra of Hitachi and Torlon imply "chemical similarity of both paints". From my viewpoint, this statement is not clear and need more discussion. Please, can you try to support the statement by qualitative or quantitative analysis of the spectra?
2. Page 87: The text of fourth paragraph suggest that better performance could be expected with the material containing "smaller sized hexagonal plates" of calcium hydroxide. Can you suggest the idea how to prepare such particles and how to incorporate them into the polymer matrix without the agglomeration?
3. The whole experimental part consists of a large combination of various experimental techniques and it is hard to expect that one person could do it. Can you give a clear view on your own contribution to the experimental results?

However, the comments and questions do not want to reduce the obvious benefits of this work. The author collected a large number of original experimental data and findings and contributed to state of the art in the field of surface modification of sliding bearings.

Finally I would like to conclude that Mr. Martin Repka, author of the submitted Doctoral Thesis, presents himself as a scientific personality and fulfill all the requirements to be awarded by the title "philosophiae doctor", Ph.D. Therefore, I recommend the Doctoral Thesis to the defense.

In Orihuela, 27. 6. 2017

A handwritten signature in blue ink, appearing to read 'Roman Čermák', followed by a stylized flourish.

doc. Ing. Roman Čermák, Ph.D.