Opponent´s review of the Master Thesis

of the Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Materials Engineering.

Title: "PLASMA SPRAYING OF CERAMICS COATINGS FOR HIGH TEMPERATURE TRIBOLOGICAL APPLICATIONS"

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Supervisor: Ing. Ladislav Cvrček, Ph.D.
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Opponent: Ing. Stanislav Sláčík, CSc.

The master thesis submitted by Kristýna Petelová deals with very attractive topic of oxides-based ceramic coatings deposition via plasma-spraying onto the heat-resistant P91 ferritic alloy steel, being for decades the workhorse of power industry.

The supervisor specifically prescribed to the author an approach as follows: "1. Literature review, 2. Preparation of the test samples from alloy P91 and plasma spraying of oxide coatings, 3. High-temperature tribological tests with increasing temperatures up to 750° C, 4. Evaluation of structure, mechanical and chemical properties at dependence on increasing temperature, 5. Results and discussion".

The presented master thesis consists of 101 pages plus block of 31 another pages of appendices under the author´s term "Attachments" (the last page left blank). The work itself has been structured into 4 chapters and contained 21 tables and 67 figures (under the author´s term "Pictures", being abbreviated as "Pic."). The work is supplemented with 74 annexes ("Attachments") being a mixture of microphotographs, tables and figures ("pictures").

The thesis being assessed starts with Task of diploma thesis (Zadání diplomové práce), a clear set of objectives to reach, completed with List of recommended literature (Seznam doporučené literatury). Declaration, Annotation, KeyWords, Acknowledgement (nota bene all the author´s gratitude being expressed solely to her parents) and Table of Contents follow.

Unfortunately, the work further on is not arranged very well. Four main chapters of work are as follow:

1. Introduction,

2. Theoretical part (In fact a literature review. Here the water-stabilized plasma method of spraying was chosen without any clarification why and why not the gas-stabilized or hybrid method.)

3. Practical part (Including point 3.3 Summary. I would prefer keeping Summary separate, not submerged into *Practical part*, due to summary´s importance.),

4. Conclusion

The **Bibliography** contains a total of 84 items, but none of the three basic works recommended by the supervisor in the Task. Curiously, two separate items are cited of the same web address – see [10] and [11].

Finally: **List of pictures**, **List of tables**, **List of attachments**, **Attachments**.

Generally, the author has demonstrated the ability of doing a surface engineering work independently and presented diploma thesis fulfils the Master thesis demands. Good hot application of oxides-coated P91 alloy has been demonstrated, including the lubricant-like behaviour of compacted oxides protective layer at elevated temperatures. The value of presented work consists in vast body of experimental data.

On the other hand, the work in review has been written in somewhat unclear manner. The literature review is unnecessarily wide, some figures has been reprinted omitting any mention of their authors' permission. Numbering of pages is confused, as seven first pages bear no number, pages since the eighth to sixteenth are numbered 1 to 9, then from the seventeenth page the numbering starts with 1 again and following pages are numbered continuously up to 85. Pages of "Attachments" are not numbered.

However, the aforementioned value of presented thesis has been further spoiled a lot via author´s careless attitude the formal rules, being accepted in the engineers and researchers community.

There is no Nomenclature, List of Symbols and Abbreviations used in submitted work. So the reader not very familiar with coatings industry can only guess what e.g. "slpm" stands for (p. 4).

Correct citation format was not met frequently (e.g. ASTM A213 instead of valid form ASTM A213/A213M-18). A key "Standard Test Method for Wear Testing with a Pin-on-Disk Apparatus, ASTM G99-17, was reported erroneously in its very obsolete version ASTM G 99-95a.

Suppliers of powder materials were not identified, e.g. "Producers of the powder were CSSR and Amperit.", see page 32. And or "glazurka Roudnice", see p. 31, and or "Producer of the powder was Prachovice", see page 30.

Figures of μ, the friction coefficient being reported in respect with path travelled by pin on the disk, given in "Attachments", are depicted in a very confusing ways, as μ is scaled by 0,5 (mentioned by very tiny symbols in the figure) so that anybody reads the value of μ approaching 2, which is a nonsense, of course.

Last but no way least, the author had not even touched the "Evaluation of … chemical properties *(of the evaluated coatings)* at dependence on increasing temperature", see the Task of diploma thesis.

Considering all the wealth of experimental data presented in the submitted work, as well as all the deficiencies compromising its value, I recommend this work for defence.

My grading is **E - Sufficiently (E – Dostatečně)**.

Questions put for defence.

The author states (page 48): "It is obvious that, as the coefficient of friction increased … , the volume loss also increased." In many cases friction and wear go hand in hand, but can be higher friction accompanied by lower wear?

The author states (page 44): "For the Al_2O_3 coating, the measured coefficient of friction were higher than expected. High friction could be caused by porosity of the coating." Could be the mechanism of friction on porosity dependence specified closer?

Further on (page 44) the author stated that the increase of (*alumina*) pin ("Attachment" 39, 40) against alumina coated disk increases with temperature. And: "This change could be caused by beginning of the oxidation." Oxidation of Al_2O_3?

Praha, August 27th, 2018,

Ing. Stanislav Sláčík, CSc.