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# OPPONENT REVIEW

**of Habilitation Thesis elaborated by Ing. Lukasz J.Orman, PhD**

on the topic

**Nucleate boiling heat transfer on heat exchangers covered with microstructure of regular geometry**

This opponent review was elaborated in reference to the letter of a principal of Mechanical Engineering Faculty at Žilina university and head of the department of Energy Technics prof. Jozef Jandačka from February 2014 to oppose the Habilitation thesis submitted by the candidate.

As I understood, this Habilitation thesis was elaborated at the Kielce University of Technology, Faculty of enviromental engineering, geomatics and power engineering, Poland. The presented thesis is focused on a specific heat transfer problematics at boiling of liquids.

Specificly, the author focused his thesis topics on phase changes at boiling of liquids related to enhances surfaces of vessels. Heat flux and heat exchange efficiency were investigated both theoretically and practically.

The thesis itself consists of seven chapters plus obvious parts as conclusion, introduction, list of indexes etc. The size of the theses is 97 pages of the author text itself, which can be considered as an appropriate size for this kind of work.

The general (and positive) constatation to this work is that **this thesis is worked out very profound and close to be perfect - both formally and contentswise.**

Author devoted lot of his effort to detailed recherche work. The recherche part of the theses takes 40 pages which is approximatelly 40% of the work . On one hand, this is a good proof that author is well oriented in the problematics, but on the other hand , the reader becomes a little bit lost from such number of names and information – often connected to the topic only marginally.

However, the core part of the thesis – that means issues related to the own scientific contribution of the candidate are presented sufficiently - later in chapters 4,5,and 6.

In chapter 4, the results of experiments are presented. Various surface structures – specificly meshes and fin pins were investigated in relationship to efficient heat flux vessel surface into the liquid. As variables, various dimensions, geometry and materials were tested. From my point of view, the experimental part of the work is the most valuable one in the thesis.

The chapter 5 presents theoretical models of boiling heat transfer at investigated conditions. Coming out from a general equtions at the page 74, and cited Smirnov theory later, the author presents a describing theoretical model. The steps in theoretical considerations are logical, well understable even if hardly to verify. However, even the theoretical erudition of the candidate is on needed level.

The chapter 6 is focused on experimental verification of pins followed by theoretical analysis – again I consider experimental values by using thermocamera as most valuable part in this chapter.

There no objections even to final conclusions – clear and short recommendations belong to a logical building of the thesis.

Formal evaluation : Formally, the theses are almost perfect including very good and understandable English, and there is hardly to find any mistakes.

Questions:

- How the theoretical considerations and equations in subchapter 6.2. were calculated and programmed, which software tool was used for that ?
- Is there any practical application of suggested methods/improvements in the industry?

**Final conclusion:** Due to high level and excellent form of presented theses I recommend the awarding the tittle „docent" (associate profesor) to Dr.Lukasz J.Orman

In Bratislava 12.3.2014

doc. Ing. Michal Masaryk, PhD.

opponent