Author of the thesis: Shehab Hassan Attia

Name of the thesis: Numerical simulation of the filling process in the pressure bottle

Type of the thesis: Diploma thesis

Reviewer: Karel Fraňa, doc.

Institution of the reviewer: TUL, KEZ

A. **Formal belongings of the thesis:** very good
(Rate linguistic and typographical level of work, text structure, sorting chapters, illustrations, correctness and completeness of citations literary sources)

The content of the diploma work is appropriately composed, chapters and sections are well ordered and number of references is adequately in respect to the research topic. The given references were indicated in the body text of the diploma work.
However, the formatting of the body text is not precisely done at several places; captions of the pictures are in a bad position not directly situated below the pictures as usually. The language style and grammar should be revised at many places.

B. **Thesis theoretical part:** Excellent
(Rate the extent and manner of research, a way of describing the problem solved or the suitability and complexity of used theoretical method.)

The main research goals and used numerical methods were adequately introduced. The strong part of the diploma work is a demonstration of experiments carried out at the German research institution BAM. These experiments were adequately described in the diploma work and the author has absolutely proved that he understand the experimental techniques and its limitations. Other numerical issues e.g. turbulence modeling, numerical schemes or grid generation etc. were discussed and presented in the body text of the diploma work or in the Appendix.
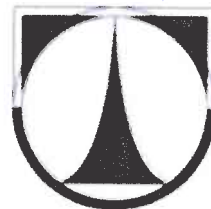
C. Thesis practical part: Excellent
(Rate adequacy and sophistication of the methods used, the level and amount of data obtained.)

Various numerical simulations were performed in order to find an appropriate solution method. For instance, the real three dimensional and two dimensional swirl axisymmetric flow simulation were tested and results were compared each other and with experimental results. The significant part of the work was to find a match between experimentally provided and numerically calculated results. The correctness of the calculation was proved by a comparative study of the temperature distribution in place and time. The pressure progress in time founded experimentally was adopted for the boundary conditions at the inlet to control the filling of the bottle. This prefunded strategy seems to be a good approach in respect to existing experimental results described in the theoretical part of the diploma work. For a simulation, the heat transfer and heat accumulation were taken into account as well.

D. Results analysis: Excellent
(Rate the level of processing of data, including the determination of measurement uncertainties, discussion of the results and formulated conclusions.)

The founded calculated results of the temperature at different places were in a good match to experiments. The selected simulation method was successfully verified having promising potential for further simulations involving non-metal basis materials. This fact is mentioned in a conclusion as well. Results of the experiments and simulations were adequately depicted in the charts demonstrating obviously a difference between experiment and simulations. Result deviations expressed by relative error were sufficiently analyzed and discussed. The author critically investigated the conditions of the experiments and numerical simulations and he founded some critical points which could have an effect on the result comparison. The most significant critical point is a filling of more than one bottle in the same time. As is discussed in the diploma work, it can influence the pressure and finally the temperature distribution in experiments.

E. **Level and quality of the thesis:** very good
(*Rate overall complexity and scope of work and original contribution of the student.*)

The level and quality of the thesis is very good. The student presented excellent results in respect to time and others possibilities which will be provided for this work.

Overall evaluation: excellent

The student manifested technical, scientific and language skills to solve a problem of the gas bottle filling. This work has been carry out in the frame of the university collaboration between TUL and German university BTU and the German research institution BAM. The founded methods and successful result validations proved a robustness of the calculation methods and wide range of applications.

Questions for the defense:

1. In case of the research of composite materials on the non-metal basis which material properties will be required for calculations of the filling process?
2. Is there any experimental investigation for non-metal bottles by which e.g. the temperature or pressure distribution in time can be obtained?

Qualification:

I suggest this work to classify as "Excellent"

In, Liberec　　　　　　　June of 7th, 2017

I certify that I am not in any personal relationship with the author of the work

Reviewer's signature