

Review of Ph.D. thesis of Ing. Eva Hnátková with title “Influence of binder composition on powder injection moulding process”

The topic of this thesis is very interesting and many laboratories all over the world perform research in the area of powder injection moulding (PIM). Polymeric binders are pre-mixed with metal or ceramic powders. The mixture is heated in a screw-fed barrel and forced under pressure into a die cavity, where it cools and is subsequently ejected. The polymer is then removed and the component sintered to the required density. The debinding stage, during which polymer is removed, can greatly influence the mechanical properties of the sintered component. A typical PIM injection moulding mix contains 35 to 50 vol% of polymer. This must be removed without causing swelling of the component, surface blistering, or the formation of large pores, which cannot be removed during sintering and so reduce the final density and compromise mechanical properties. Multicomponent binder systems, where the polymers are removed by solvents or degrade at different points of a thermal debinding cycle, have shown considerable potential for minimising debinding defects.

The whole thesis consists of 100 pages. On the 18 pages of theoretical background student well explained the most important points of the research. Experimental part on 18 pages describes material preparation, thermal analysis, formulation, processing, mixing, debinding, sintering and cooling, rheology and mechanical properties measurement. Results and discussions are on 33 pages.

Web of Science results: 5 articles; in 2 of them she is listed as first author. Name of the journals are: Polymer Degradation and Stability, Materiali in Tehnologije, Polymer Engineering and Science, Powder Technology 2x.

Altogether this research was performed on high level with great number of experiments. Student has shown the ability to study literature, perform experiments, analyze experiments and summarize them into well-arranged form.

This doctoral thesis does not contain visible flaws and therefore I recommend it for defense.






On the basis of above mentioned facts I recommend Eva Hnátková to obtain a Ph.D. title.

Questions:

1) Page 63, DSC results. When you calculate the crystallinity corrected to the weight of the component, what is the change caused by mixing? You wrote that this is the 2nd heating scan. How the curve looks during cooling cycle? Is there an influence on crystallization? Could you analyse the crystallization kinetics quantitatively according some major crystallization theory?

2) Page 69. You are showing SEM of Al₂O₃ particles. Please make and show us a histogram of particle sizes.

Web of Science – articles (06.05.2019)

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<input type="checkbox"/>	1. Influence of capillary die geometry on wall slip of highly filled powder injection molding compounds By: Sanetnik, Daniel; Hausnerova, Berenika; Filip, Petr; et al. POWDER TECHNOLOGY Volume: 325 Pages: 615-619 Published: FEB 1 2018  <input type="button" value="Full Text from Publisher"/> <input type="button" value="View Abstract"/>	Times Cited: 0 <i>(from Web of Science Core Collection)</i> Usage Count ▼
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In Zlín 06.05.2019

prof. Ing. Petr Svoboda, Ph.D.
 Univerzita Tomáše Bati ve Zlíně
 Fakulta technologická
 Vavrečkova 275, 76272 Zlín