Comprehensive characterization and material modeling for ceramic injection molding simulation performance validations

Powder injection molding is like the process of plastics injection molding capable of the mass production of highly functional complex 3D parts, just in ceramics and metals. The market for products made by powder injection molding is constantly growing. With this growth, the need for reliable process simulations arises. Simulation tools are widely used in the development of new products and are applied in powder and polymer injection molding to support the product design, shorten the development time, avoid errors, and help to optimize the mold and process design. However, material data for feedstocks and thus simulations of the powder injection molding process are hardly available yet. The present work introduces the necessary material data for establishing a material model for simulations. An extensive material characterization of ceramic feedstocks was conducted. The material investigations comprised the determination of basic, thermal, and rheological material properties to collect a comprehensive data set. The necessary measurements and tools are outlined and their results are discussed in detail with regard to powder content and in comparison to pure plastics. The gained data enabled to successfully create a material model for mold filling simulations. Powder injection molding experiments were carried out with a spiral test geometry. The mold was equipped with a sensor array for the process monitoring during injection. Furthermore, a simulation model of the test geometry was established. Finally, the results of the experiments and simulations are discussed and are compared to validate the performance of the simulations. The results showed the potential and limitations of process simulations and standard software applied in conventional and micro powder injection molding.

General information
State: Accepted/In press
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Acoustic Technology, University of Applied Sciences Northwestern Switzerland, Karlsruhe Institute of Technology
Contributors: Tosello, G., Marhöfer, D. M., Islam, A., Müller, T., Plewa, K., Piotter, V.
Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: International Journal of Advanced Manufacturing Technology
ISSN (Print): 0268-3768
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.8 SJR 0.994 SNIP 1.697
Web of Science (2017): Impact factor 2.601
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.3 SJR 1.046 SNIP 1.608
Web of Science (2016): Impact factor 2.209
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.8 SJR 0.889 SNIP 1.325
Web of Science (2015): Impact factor 1.568
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.03 SJR 1.082 SNIP 1.841
Web of Science (2014): Impact factor 1.458
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.26 SJR 1.134 SNIP 2.131
Web of Science (2013): Impact factor 1.779
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.75 SJR 0.971 SNIP 2.099