Gate Design in Injection Molding of Microfluidic Components Using Process Simulations -
DTU Orbit (12/12/2018)

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Just as in conventional injection molding of plastics, process simulations are an effective and interesting tool in the area of microinjection molding. They can be applied in order to optimize and assist the design of the microplastic part, the mold, and the actual process. Available simulation software is however actually made for macroscopic injection molding. By means of the correct implementation and careful modeling strategy though, it can also be applied to microplastic parts, as it is shown in the present work. Process simulations were applied to two microfluidic devices (microfluidic distributor and a mixer). The paper describes how the two devices were meshed in the simulations software to obtain a proper simulation model and where the challenges arose. One of the main goals of the simulations was the investigation of the filling of the parts. Great emphasis was also on the optimization of selected gate designs for both plastic parts. Subsequently, the simulation results were used to answer the question which gate design was the most appropriate with regard to the process window, polymer flow, and part quality. This finally led to an optimization of the design and the realization of this design in practice as actual steel mold. Additionally, the simulation results were critically discussed and possible improvements and limitations of the gained results and the deployed software were described. Ultimately, the simulation results were validated by cross-checking the flow front behavior of the polymer flow predicted by the simulation with the actual flow front at different time steps. These were realized by molding short shots with the realized molds and were compared to the simulations at the global, i.e., part level and at the local, i.e. feature level.

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Acoustic Technology
Number of pages: 12
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Journal of Micro and Nano-Manufacturing
Volume: 4
Issue number: 2
Article number: 025001
ISSN (Print): 2166-0468
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 0.71 SJR 0.236 SNIP 0.47
Web of Science (2017): Indexed yes
Scopus rating (2016): SJR 0.273 SNIP 0.737
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.297 SNIP 0.419
Scopus rating (2014): SJR 0.319 SNIP 0.598
Original language: English
Keywords: Micro-injection molding, Simulation, Meshing, Gate design, Microfluidic system, Short shots
DOI: 10.1115/1.4032302
Source: PublicationPreSubmission
Source-ID: 122717744
Research output: Research - peer-review | Journal article – Annual report year: 2016