Material and Parameter Analysis of the PolyJet Process for Mold Making Using Design of Experiments

Authors : A. Kampker, K. Kreisköther, C. Reinders

Abstract : Since additive manufacturing technologies constantly advance, the use of this technology in mold making seems reasonable. Many manufacturers of additive manufacturing machines, however, do not offer any suggestions on how to parameterize the machine to achieve optimal results for mold making. The purpose of this research is to determine the interdependencies of different materials and parameters within the PolyJet process by using design of experiments (DoE), to additively manufacture molds, e.g. for thermoforming and injection molding applications. Therefore, the general requirements of thermoforming molds, such as heat resistance, surface quality and hardness, have been identified. Then, different materials and parameters of the PolyJet process, such as the orientation of the printed part, the layer thickness, the printing mode (matte or glossy), the distance between printed parts and the scaling of parts, have been examined. The multifactorial analysis covers the following properties of the printed samples: Tensile strength, tensile modulus, bending strength, elongation at break, surface quality, heat deflection temperature and surface hardness. The key objective of this research is that by joining the results from the DoE with the requirements of the mold making, optimal and tailored molds can be additively manufactured with the PolyJet process. These additively manufactured molds can then be used in prototyping processes, in process testing and in small to medium batch production.

Keywords : additive manufacturing, design of experiments, mold making, PolyJet, 3D-Printing