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Ultrasonic Micro Injection Molding: Manufacturing of Micro Plates of Biomaterials

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Abstract : Introduction: Ultrasonic moulding process (USM) is a recent injection technology used to manufacture micro components. It is able to melt small amounts of material so the waste of material is certainly reduced comparing to microinjection molding. This is an important advantage when the materials are expensive like medical biopolymers. Micro-scaled components are involved in a variety of uses, such as biomedical applications. It is required replication fidelity so it is important to stabilize the process and minimize the variability of the responses. The aim of this research is to investigate the influence of the main process parameters on the filling behaviour, the dimensional accuracy and the cavity pressure when a micro-plate is manufactured by biomaterials such as PLA and PCL. Methodology or Experimental Procedure: The specimens are manufactured using a Sonorus 1G Ultrasound Micro Molding Machine. The used geometry is a rectangular micro-plate of 15x5mm and 1mm of thickness. The materials used for the investigation are PLA and PCL due to biocompatible and degradation properties. The experimentation is divided into two phases. Firstly, the influence of process parameters (vibration amplitude, sonotrodo velocity, ultrasound time and compaction force) on filling behavior is analysed, in Phase 1. Next, when filling cavity is assured, the influence of both cooling time and force compaction on the cavity pressure, part temperature and dimensional accuracy is instigated, which is done in Phase. Results and Discussion: Filling behavior depends on sonotrodo velocity and vibration amplitude. When the ultrasonic time is higher, more ultrasonic energy is applied and the polymer temperature increases. Depending on the cooling time, it is possible that when mold is opened, the micro-plate temperature is too warm. Consequently, the polymer relieve its stored internal energy (ultrasonic and thermal) expanding through the easier direction. This fact is reflected on dimensional accuracy, causing micro-plates thicker than the mold. It has also been observed the most important fact that affects cavity pressure is the compaction configuration during the manufacturing cycle. Conclusions: This research demonstrated the influence of process parameters on the final micro-plated manufactured. Future works will be focused in manufacturing other geometries and analysing the mechanical properties of the specimens.

Keywords : biomaterial, biopolymer, micro injection molding, ultrasound
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