Equipment for Additive Manufacturing of Biocompatible Silicone

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Abstract. Additive Manufacturing (AM) is a flexible technology based on layer-by-layer fabrication strategy that allows the production of small and medium batches of complex parts. Thanks to these advantages AM is suitable for customized components fabrication, in particular in the biomedical sector where the possibility to produce custom-made devices with complex geometry represents a considerable improvement in patient care. In this field, biomedical silicone, currently not processable by AM techniques, is a great research challenge. This work focuses on the development of an extrusion based 3D printing process equipment for two-component and biocompatible silicones. The main problem when processing these silicones is the curing time that brings to the full solidification of the polymer. In fact, this material is characterized by a too short curing time (tens of minutes) when compared with the processing time of AM (hours or even days). Therefore, the research work presented in this paper aims to overcome this limitation through the development of a new extrusion head able to extend the processing time of the material. In particular, dimensioning, design and realization phases of a modular extrusion head are presented. The extrusion head is equipped with a cooling system able to keep the silicone at low temperature in order to slow down the curing kinetics. Furthermore, the results of the testing phase performed to evaluate the behavior and the optimal operating conditions of this equipment are provided. This work demonstrates the effectiveness of the proposed solution in reaching suitable temperatures to extend the time window of AM process for biocompatible silicones. The developed equipment overcomes the main issues related to the biomedical silicones processing with AM, and shows a potential application in customized medical devices production.