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Impact of post-processing stages on vat-photopolymerized specimens

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Abstract

Vat photopolymerization additive manufacturing (VPAM) is a technology with a promising future gaining interest from different industries and academic disciplines, such as biology, medicine, robotics and material science just to name a few1–5. To achieve repeatable, high-quality features, it is imperative to control all the stages of the VPAM manufacturing chain. At micro-scale, the post-processing procedure has a major impact on the part quality and mechanical properties 6. The classic post- processing chain consists of an isopropanol rinse, ultrasound cycle, pressurized air dry and ultraviolet post-curing bath. Little has been found in the literature that covers each mentioned step, where the majority of studies solely cover the last phase, i.e. post-curing6–9. This work intends to quantify how each of these phases interact with each other and how it affects the final product in order to design a controlled post-processing routine that ensures the highest part quality.

A Placket-Burrman design of experiments was used to study the main effect and interaction of six factors of the post-process. These factors are, time and temperature the specimen is under the ultrasonic bath, time and temperature in a vacuum dry oven, and time and temperature in the ultraviolet post-curing bath. The initial results indicated that the incorporation of vacuum drying guarantees greater stability throughout the shelf life of the samples, where a significant weight loss over time was observed on the parts dried only with pressurized air. The experimental post-processing routines with six variables showed significant differences on their mechanical properties and their surface quality. The main effect and interaction plots revealed that each variable sensitive to the change of the other factor's values, proving that each phase of the post-process is accountable for the performance of the final part.

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