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Influence of Post-Processing on the Properties of Multi-Material Parts Obtained by Material Projection AM

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Abstract: The great geometric complexity that additive manufacturing allows in parts, together with the possibility of combining several materials in the same part, establishes a new design and manufacturing paradigm. Despite the interest of many leading sectors, the lack of standardization still makes it necessary to carry out characterization work to enjoy these advantages in functional parts. In many of these techniques, the process does not end with the end of the machine cycle, but different post-processing must be carried out to consider the part finished. It has been found that the type of post process applied can have a similar effect on part quality as other further studied process parameters. In this work, the material projection technique was used to manufacture multi-material parts combining resins with different mechanical properties. The influence of different post-processing on the tensile behavior of these parts was analyzed. The results show the detrimental effect of ultrasonic treatment with isopropyl alcohol in the case of the more flexible resin mixtures, being advisable to use ultrasonic with mineral oil or furnace treatment. For more rigid mixtures, the furnace is the best option, although the other post-processing techniques do not significantly deteriorate their performance.

Keywords: additive manufacturing; multi-material; material projection; post-processing

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1. Introduction

Additive manufacturing technology (AM) is based on part manufacturing by adding layers of material. Originally called rapid prototyping, it was conceived to produce prototypes quickly and easily from digital models. Given its advantages in terms of simplicity of use, great freedom of design and customization without a significant increase in cost, the possibility of reducing the number of components, etc., it is currently of great interest to many sectors such as medical [1], aerospace [2], energy industry [3], sports [4,5], and those geared towards the manufacture of micrometer-scale components [6].

One of the AM techniques that has received great attention in recent times is the Material Projection (MP) technique [7]. This technique allows for the addition of material layers by selective deposition of light-curing resin droplets that are subsequently cured by an ultraviolet light source. For this purpose, AM machines have a head that incorporates piezoelectric injectors arranged in a matrix to deposit the resin, as well as a blade or roller and several ultraviolet light lamps, which flatten and cure the resin once it has been deposited [8].

The main manufacturers of AM machines based on this technique (3D Systems [9] and Stratasys [10]) have developed equipment capable of mixing several light-curable polymer resins simultaneously at the voxel level (3D pixel) to manufacture multi-material parts [11,12]. This new paradigm undoubtedly marks a milestone in terms of the ability to