Recycled PET for 3D Printing and How the Filament Dimension Influences Strength and Quality in 3D Printed Parts

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This study evaluates the reuse of polyethylene terephthalate (PET) from plastic bottles for filament production in 3D printing via thermoplastic pultrusion, using a PET Machine based on the Igor Tylman model. The main focus was to analyze how the controlled reduction of material, determined by the width of the PET strips, influences the strength and quality of the filament's mechanical properties. The methodology consisted of calculating a theoretical strip width based on the ratio between the PET Machine nozzle circumference (1.70 mm diameter) and the PET bottle wall thickness (~0.308 mm). From this value (~7.36 mm), strips were cut, progressively reducing the amount of material by -0.10 mm, -0.20 mm, and -0.30 mm. These strips were processed by extrusion at approximately 230 °C to generate continuous filament. Subsequently, the resulting filament was separated in experimental tests: (1) Separation of samples of different filaments with varying amounts of material for tensile testing. (2) Printing of test models to evaluate behavior during the FDM process. The results show that material reduction has a direct effect on filament quality and mechanical performance. The extrusion force and the applied heat being the two parameters that determine this behavior. The strip with a reduction of -0.10 mm (~7.26 mm) exhibited the best performance, allowing for stable extrusion without underextrusion or jamming, as well as more predictable mechanical behavior. Larger reductions increased filament stiffness but decreased its deformation capacity and negatively impacted process stability.

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