

The Effect of Print Speed on Tensile Properties of 3D Printed PLA

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Structured Abstract

Background: Additive manufacturing, also referred to as three-dimensional (3D) printing, has undergone significant development and has become widely used. Although this manufacturing was once used for prototyping, it is now employed for the quick production of finished goods. 3D printing has been affected by different parameters during preparation, printing, and post-printing processes, which have influence on quality and behavior of the additively manufactured components. Although parameters like infill pattern and infill density have been extensively studied, the effect of print speed is less well-known. Therefore, more information is required to determine how printing speed affects the tensile characteristics of 3D samples.

Methods: In this study, PLA material was used for fabrication of the test specimens based on the Fused Filament Fabrication (FFF) process. The specimens are designed according to ASTM D638 Type 1. SolidWorks software was used to create a 3D, Ultimaker Cura software was employed as slicing software and the specimens were printed using Ultimaker 3D printer. The samples were printed using triangle and tri-hexagon as infill pattern and the infill density is set at 20%. The printing speed used in this research ranged from 50 to 75 mm/s. Tensile tests were performed at a 5 mm/min test speed. Tensile strength, Young's modulus, and elongation at break were obtained from these tests.

Results: In this study, we have documented that the Young's modulus and tensile strength of the items decreased as printing speed increased. In detail, higher speed can reduce the extrusion volume which decreased printing stability. The result shows that the adhesion between printed layers can be impacted by print speed. Higher print speeds could result in insufficient layer bonding and weakened structural integrity. Elongation at break has increased as a result of the print speed reduction at low speeds.

Conclusion: In conclusion, the study demonstrates that the printing speed has a significant impact on the tensile properties of 3D printed PLA parts. Specifically, the tensile strength shows no significant decrease, but Young's Modulus significantly decreases with increasing printer speed.

Keywords: PLA; 3D printing; Fused Filament Fabrication; Print speed; Tensile test

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