Mechanical property of FDM printed ABS : influence of printing parameters

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ABSTRACT

Fused deposition modeling (FDM) technology works with specialized 3D printers and production-grade thermoplastics to build robust, durable, and dimensionally stable parts with the best accuracy and repeatability of any other available 3D printing technology. FDM is one of the highly used additive manufacturing technology due to its ability to manufacture very complex geometries. However, the critical problems with this technology have been to balance the ability to produce esthetically appealing products with functionality and properties at the lowest cost possible. In this study, three major process parameters such as layer height, raster angle, and infill density have been considered to study their effects on mechanical properties of acrylonitrile butadiene styrene (ABS) as this material is widely used industrial thermoplastic in FDM technology. The test results show a clear demonstration of the considered factors over the mechanical variables measured. Response surface methodology is used for the validation of the experimental data and the future prediction of the test results. It was found that the optimum parameters for 3D printing using ABS are 80% infill percentage, 0.5 mm layer thickness, and 65° raster angle. The achieved experimental ultimate tensile strength, elastic modulus, yield strength, fracture strain, and toughness (energy absorption) are 31.57 MPa, 774.50 MPa, 19.95 MPa, 0.094 mm/mm, and 2.28 Jm^{-3}, respectively. Mathematical equation has been developed using surface response methodology which can be used to predict the ABS tensile properties numerically and also to predict the optimum parameter for ultimate properties.

KEYWORDS

Acrylonitrile butadiene styrene (ABS); Tensile test; Fused deposition modeling; Layer thickness; Infill percentage; Raster angle

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