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Mechanical and Physical Properties of Desktop Stereolithography 3D Printing Materials

Abstract

Stereolithography (SLA) is a form of 3D printing technology in additive manufacturing (AM) that uses a light source either a laser or a projector to cure photosensitive resins into hardened plastics to create objects based on the 3D file format. Material properties are an important aspect in engineering so that suitable materials can be determined for a certain application. In this study, related specimens were fabricated using high temp (HT) SLA resin with different layer thicknesses to evaluate the mechanical and physical properties namely tensile strength, impact resistance, hardness, and density. Based on the experimental results, the ultimate tensile strength (UTS) for high temp resin with layer thickness (LT) of 100 µm was better than LT setting of 25 µm with values of 72.84 MPa and 66.82 MPa, respectively. Meanwhile, the impact resistance values obtained from the test showed HT resin with 50 µm LT of printed notched specimens (PN) produced higher impact resistance than machine notched (MN) specimens with values of 22.866 J/m and 15.685 J/m. The hardness readings obtained from the 8 mm specimen thickness for 50 µm LT and 100 µm LT were 87.5 Shore D and 86.4 Shore D. Obviously, thicker specimen thickness result in slightly higher hardness measurements, but the difference was not large. The density values for 100 µm LT and 50 µm LT were 1.2114 g/cm3 and 1.2047 g/cm3, respectively. When compared with the uncured resin, the density of the post-cured condition was slightly denser. Based on the findings, the layer thickness was an important factor that can contribute to the properties of the material. In addition, the stereolithography post-curing process also has an influence on the mechanical properties. Comparisons made with an industrial-grade resin also show that desktop SLA that use high temp resins are considered capable of producing parts comparable to the quality produced by industrial-grade SLA machines.