Effects of Infill Pattern and Percentage on Post-Annealing Dimensions of PLA and Carbon-PLA 3D Prints

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In Additive Manufacturing, or 3D printing, a printed object can be strengthened in a process known as annealing, which heats the object above the “glass” temperature but below the melting temperature and causes the material to relieve some of the stresses within. However, this process can introduce different stresses to the object which may affect the quality of the object. This study aimed to look at the role of infill pattern, percentage, and printing material in this “warping” during the annealing process. Three infill patterns were studied: triangular, tri-hexagonal, and grid. Each pattern was printed at 20%, 40%, 60%, and 80% infill. This process was done with both regular polylactic acid (PLA) and carbon-reinforced PLA. Printing was done with a nozzle temperature of 215°C and a bed temperature of 75°C. Multiple models (25x25x25mm cubes) were printed for each pattern, percentage, and material and the average of the dimensions was taken for each model. After printing, the models were annealed in the 3D printer overnight at 95°C and measurements were taken again. The change in length of each dimension was calculated, and from that the linear strain was calculated for each model type. From the data collected, material type appeared to have the biggest impact on strain: the regular PLA expanded more than the Carbon-PLA. Also, for both material types and for all patterns and percentages, the most growth happened in the z-dimension. Further studies may investigate the general structural sturdiness of the least affected parameters in this study and see how applicable objects with these infill parameters are in industrial fields.