Effects of CNC machining on surface roughness in Fused Deposition Modelling (FDM) products

ABSTRACT

Fused deposition modelling (FDM) opens new ways across the industries and helps to produce complex products, yielding a prototype or finished product. However, it should be noted that the final products need high surface quality due to their better mechanical properties. The main purpose of this research was to determine the influence of computer numerical control (CNC) machining on the surface quality and identify the average surface roughness (Ra) and average peak to valley height (Rz) when the specimens were printed and machined in various build orientations. In this study, the study samples were printed and machined to investigate the effects of machining on FDM products and generate a surface comparison between the two processes. In particular, the block and complex specimens were printed in different build orientations, whereby other parameters were kept constant to understand the effects of orientation on surface smoothness. As a result, wide-ranging values of Ra and Rz were found in both processes for each profile due to their different features. The Ra values for the block samples, printed samples, and machined samples were 21, 91, and 52, respectively, whereas the Rz values were identical to Ra values in all samples. These results indicated that the horizontal surface roughness yielded the best quality compared to the perpendicular and vertical specimens. Moreover, machining was found to show a great influence on thermoplastics in which the surfaces became smooth in the machined samples. In brief, this research showed that build orientation had a great effect on the surface texture for both processes.

Keyword: Additive manufacturing; Fused deposition modelling; Computer numerical control; Surface roughness; Machining; FDM; CNC; Polylactic acid (PLA)