Investigation of bending and compression properties on PLA-brass composite using FDM

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ABSTRACT

Fused Deposition Modeling (FDM) is often favored over conventional techniques as it can produce highly accurate three-dimensional models with minimal material waste. Nevertheless, in FDM, the mechanical properties of different materials used in the FDM process are of ongoing interest. Since the properties of brass alloys in the FDM process are still lacking, the present study focuses on the bending and compression properties of the FDM printed part with 15 wt% and 70 wt% of brass-reinforced polylactic acid (PLA) and various infill patterns. The specimen preparation and testing were carried out accordingly to ASTM D790 and ASTM D695, respectively. The impact of five different infill patterns and two different compositions on the bending and compression properties was also analyzed using response surface methodology. A prediction model is then developed to predict the desired bending and compression properties. Results show that the 15 wt% of brass composition specimens have better properties compared with the 70 wt% of brass composition. This is due to an increase in the wt% of brass composition, which resulted in lower interlayer adhesion energy with the PLA. It was also found that the concentric and grid pattern are the best printing pattern for bending and compression properties, respectively.

KEYWORDS: Fused deposition modeling, Polylactic acid, Brass, Mechanical properties

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REFERENCES

1. Ando, ` B., Baglio, S., Bulsara, A.R., Emery, T., Marletta, V., Pistorio, A., 2017. Low-cost inkjet printing technology for the rapid prototyping of transducers. Sensors 17 (4), 1–11. https://doi.org/10.3390/s17040748.

2. Braconnier, D.J., Jensen, R.E., Peterson, A.M., 2020. Processing parameter correlations in material extrusion additive manufacturing. Addit. Manuf. 31 https://doi.org/10.1016/j.addma.2019.100924.

3. Carlier, E., et al., 2019. Investigation of the parameters used in fused deposition modeling of poly (lactic acid) to optimize 3D printing sessions. Int. J. Pharm. 565, 367–377. https://doi.org/10.1016/j.ijpharm.2019.05.008.

4. Dini, F., Ghaffari, S.A., Jafar, J., Hamidreza, R., Marjan, S., 2020. A review of binder jet process parameters; powder, binder, printing and sintering condition. Met. Powder Rep. 75 (2), 95–100. https://doi.org/10.1016/j.mprp.2019.05.001.

5. Kottasamy, A., Samykano, M., Kadirgama, K., Rahman, M., Noor, M.M., 2022. Experimental investigation and prediction model for mechanical properties of copper-reinforced polylactic acid composites (Cu-PLA) using FDM-based 3D printing technique. Int. J. Adv. Manuf. Technol. 119 (7–8), 5211–5232. https://doi.org/10.1007/s00170-021-08289-4

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