Mechanical behaviour of the post processed 3D printed PLA parts using polar and non-polar solvents

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Aims and scope

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Abstract

FDM, being the most popular AM technology, has a wide user base across the globe. The process makes use of a layer-by-layer approach, causing a staircase effect on the material's printed surface. Though it affects several mechanical properties, its effect on surface integrity is highly detrimental and needs to be addressed. Chemical vapour dip and immersion techniques can provide a rapid solution using solvents. The solvents employed in the current study were the polar solvents- acetone and ethyl acetate, the mid-polar solvent- tetrahydrofuran (THF), and the non-polar solvents- chloroform and dichloromethane (DCM). The superior surface finish obtained during the post processing of 3D printed parts was having mean roughness value (R_a) of 0.67 µm, originally 11.42 µm. It was obtained when experimentation was carried out with the chemical vapour technique using THF. The optimum surface finish was readily achieved with mid- and non-polar solvents, whereas the polar solvents were slow to react with the surface of the PLA. A number of variables, including the solvent's polarity, boiling point, vapour pressure, and water miscibility, have an impact on the final surface's appearance and strength. During vapour treatment, the tensile strength of the 3D printed parts got reduced between 11.6% (THF) to 43.78% (DCM). On the other hand, the chemical immersion technique has a even more impact on the material's strength and hardness. It reduces hardness to the maximum of 44.41% (THF), whereas the vapour evaporation technique reduces hardness by only up to 14.64% (chloroform).

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Contributions

JN contributed to conceptualization, experimentation, methodology, visualization, investigation, data curation, original drafting, writing–reviewing and editing. AH contributed to methodology, validation, proof reading, project administration, supervision. AAD contributed to experimentation, validation, project administration.

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Ethics declarations

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Additional information

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