JOURNAL OF THERMOPLASTIC COMPOSITE MATERIALS

Original Article

Journal of Thermoplastic Composite Materials
2022, Vol. 35(11) 2052–2061

DOI: 10.1177/0892705720945371
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Properties investigation of 3D printed continuous pineapple leaf fiber-reinforced PLA composite

Jaya Suteja, Hudiyo Firmanto, Arum Soesanti and Christian Christian

Abstract

Previous researchers tried to improve the mechanical properties of 3D printed part by adding short or continuous, natural, or nonnatural fibers as the reinforcement for thermosetting or thermoplastic matrix. None of the research found in the literature incorporates continuous natural pineapple leaf fiber as the reinforcement for polylactic acid (PLA) matrix by using 3D printing. The objective of this research is to investigate the tensile strength, the elongation, and the dimensional error of the 3D printed parts made of continuous pineapple leaf fiber-reinforced PLA composite using different values of extrusion temperature and feed rate. The experiment involves 3^2 factorial design with two replications and, therefore, prints 18 tensile test specimens according to ASTM D638. Based on the result of the experiment, it can be concluded that the use of continuous pineapple leaf fiber as the reinforcement for the PLA matrix increases the tensile strength of the composite. The use of continuous pineapple leaf fiber does not increase the dimensional error value of the composite part beyond the maximum value of the common fused deposition modeling printed part. Moreover, the required time to print the composite part is the same as the required time to print the pure PLA part. However, the elongation of the composite part is lower than the pure PLA part.

Keywords

3D printing, pineapple leaf, continuous fiber, polylactic acid, composite, properties

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Introduction

The emergence of 3D printing, or is commonly referred to as additive manufacturing, is triggered by the need to deliver a product prototype to a customer in shorter time duration. Later, 3D printing is mostly being applied to build various customized products. Customized products are products that are made by order with small production volume. Fused deposition modeling (FDM) is the most widely applied 3D printing technology. The FDM works by extruding thermoplastic material, which has been heated up to its melting point through a nozzle and then depositing the extruded material layer by layer.

Various thermoplastic polymers such as polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), and polyimide are being used as the material of FDM in the shape of filament. The ABS material has better ductility, elongation, and flexural strength compared to the PLA material, but it emits gas in the printing process. The PLA material is more environmentally friendly material than the ABS material because it is produced from renewable resources and degrades faster than the ABS material. However, the PLA material is stiffer and more brittle than the ABS material.[1]

Despite the wide applications of the FDM 3D printer, the part printed by using the technology has low mechanical properties. As a result, the printed part has a limitation to be used as a structural part. Additional materials as reinforcement need to be added to the polymer matrix to achieve better mechanical properties of the composite material.[2] Furthermore, the addition of the reinforcement could produce a lighter composite. However, the addition will reduce the quality of the surface finish and increase the dimensional error of the printed part.

Previous researchers tried to improve the mechanical properties of 3D printed part by adding short or continuous carbon, glass, and aramid fibers as the reinforcement for thermosetting or thermoplastic polymer matrix.[3–11] However, these fibers are categorized as nonnatural and nonrenewable materials. As a result, they are not environmentally friendly and limited in supply.

Therefore, other research investigated the addition of various short or continuous natural fibers as the reinforcement for thermosetting or thermoplastic polymer matrix.[12] These researchers studied the effect of the natural fibers content on the mechanical properties of the composite. The natural fibers are derived from bamboo,[13] coconuts,[14] oil palm,[15] banana,[16] kenaf,[17,18] or pineapple[19,20] tree. They could be obtained as harvested or industrial waste products. The natural fibers offer many advantages compared to the nonnatural fibers such as lighter, stiffer, stronger, easier to recycle, easier to degrade, and cheaper.[21–26] The research found that the addition of the natural fibers increases the mechanical properties of the composite.

According to Yang et al.,[7], Parandoush and Lin,[26] Naranjo-Lozada et al.,[12] Matsuzaki et al.,[27] Namiki et al.,[28] Tian et al.,[29] and Harris et al.,[30] the use of continuous fibers as the reinforcement creates a composite that has better mechanical properties compared to the use of short fibers. However, the use of continuous fibers as the reinforcement causes difficulties in the 3D printing. It requires an additional process to incorporate continuous fibers into the matrix. In addition, the printing process requires different process parameters compared to the use of pure material.

Pineapple leaf fiber is a natural material that is extracted from a pineapple leaf. The fiber is obtained by separating the fiber and the gummy substance of the pineapple leaf. The fiber is mostly used as materials for textiles, wallpaper, and rope. The shape and the dimension of the fiber make it possible to insert the fiber into the 3D printer nozzle. The length of the cylindrical fiber ranges from 55 cm to 75 cm with a diameter between 0.1 mm and 0.5 mm. The fiber also has higher tensile strength compared to other natural fibers. According to Sanjay et al.[23] and Saba et al.[18], the tensile strength of the pineapple leaf fiber is between 170 MPa and 1627 MPa and its elongation is between 0.8% and 2.4%. Therefore, the pineapple leaf fiber is a promising material as the reinforcement for the polymer matrix.

Previous studies found in the literature focused on the use of nonnatural fibers such as carbon, glass, Kevlar, and aramid fibers in the continuous fiber-reinforced composite material for 3D printing.[7,12,27,28,29] None of the research found in the literature incorporates continuous pineapple leaf fiber as the reinforcement for the PLA matrix by using 3D printing. The use of the continuous pineapple leaf fiber as the reinforcement for the PLA matrix is expected to create an environmentally friendly composite that has better mechanical properties. The objective of this research is to investigate the properties of 3D printed parts made of continuous pineapple leaf fiber-reinforced PLA composite using various values of printing process parameters. The investigated properties of the printed part are limited to tensile strength, elongation, and dimensional error. In addition, this research also collects the printing time data to have insight related to the productivity of the 3D printing process that uses continuous pineapple leaf fiber as the reinforcement. The results of this research will pave a way for the use of continuous pineapple leaf fiber as the reinforcement for the PLA matrix in producing an environmentally friendly part with better mechanical properties by using 3D printing.

Experimental setup

The 3D printer used in this research is ANET A8 3D Printer Prusa I3, manufactured by Shenzhen Anet Technology Co., Ltd., with a print area of 220 mm × 220 mm × 240 mm. The printer has extruder equipment with a 0.4 mm nozzle diameter. The extruder equipment also consists of roll feeder and hotend components. The roll feeder is used to feed the material and the hotend is used to heat the material. The components of the extruder equipment and how the pineapple leaf fiber is incorporated with the PLA filament in the extruder equipment are shown in Figure 1.

First, the pineapple leaf fiber as the reinforcement and the PLA filament as the matrix are inserted at the input hole of the extruder equipment. The pineapple leaf fiber is prepared to have a diameter of 0.1 mm. The PLA matrix is fabricated into a filament shape with a diameter of 1.75 mm. The diameter of the PLA filament follows the requirement of a 3D printer. Then, the fiber and the filament are fed to the hotend by using the roll feeder and heated by the hotend. The pineapple leaf fiber and the PLA filament are combined in the extruder equipment with the volume ratio 1:4. The fiber and the filament are combined at the hotend to form a melting PLA composite. After that, the

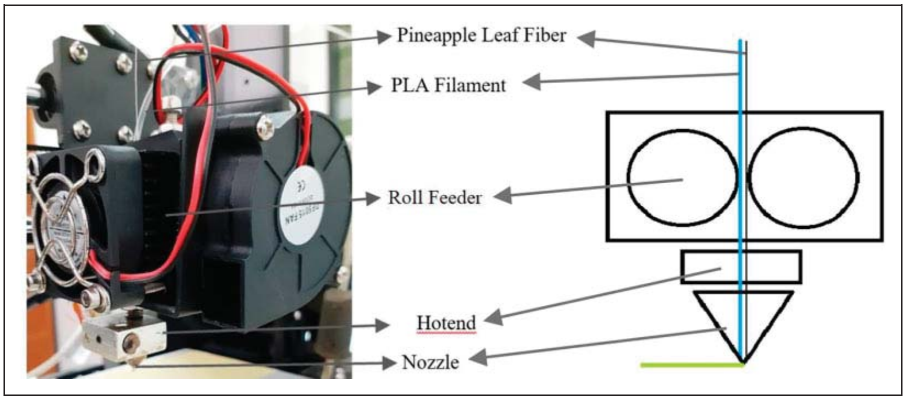

Figure 1. Extruder equipment and incorporation process.

Table 1. Value of each variable parameter.

Parameters	Values		
	Low	Middle	High
Extrusion temperature (°C)	200	205	210
Feed rate (mm/s)	15	20	25

melting PLA composite is extruded through the nozzle. Finally, the composite material is printed layer by layer to build a printed part.

To generate the printing path of the nozzle, Slic3r Prusa software, developed by Prusa Research, and Repetier-Host software, developed by Hot-World GmbH & Co. KG are used. Both are also applied to set the 3D printing process parameters. According to Suteja and Soesanti, mechanical properties of a 3D printed part are affected by various printing parameters such as build orientation, layer thickness or layer height, feed rate or infill deposition rate, infill density, deposition angle or raster angle or infill angle, extrusion temperature, infill pattern, number of outer shell layers, shell thickness, material type, printer type, strain rate, coloring agent, and nozzle diameter or infill width.[31] This research investigates the properties of 3D printed parts made of the composite material for different values of extrusion temperature and feed rate as presented in Table 1.

The extrusion temperature values are determined based on the condition of the pineapple leaf fiber. If the extrusion temperature is set below 200°C, the fiber will not able to be inserted through the nozzle. At the temperature, the PLA filament is too viscous and causes the fiber to be stuck in the hotend. Meanwhile, the pineapple leaf fiber will be burned in the hotend, if the extrusion temperature is set above 210°C. Therefore, this research implements three-extrusion temperature values between

Table 2. Value of each constant parameter.

Parameters	Values
Layer thickness (mm)	0.5
Number of outer shell layers	2
Shell thickness (mm)	0.4
Layer width (mm)	0.4
Infill pattern	Rectilinear
Infill angle (°)	45
Infill density (%)	100
Bed temperature (°C)	65
Build orientation	X–Y
Diameter filament (mm)	1.75

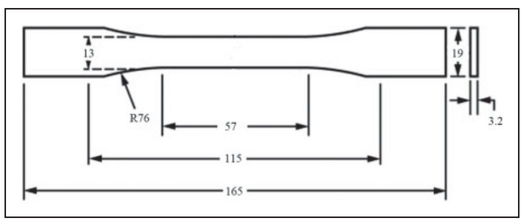

Figure 2. Specimen dimension (in millimeter).

200°C and 210°C. Furthermore, the feed rate value should not be set below 15 mm/s. At the feed rate, the pineapple leaf fiber is charred and broken up in the hotend. Meanwhile, the feed rate value above 25 mm/s causes the pineapple leaf fiber to be broken because the movement of the nozzle results in the fiber receives excessive tension. The other 3D printing process parameters are determined as constant values based on the tools and material catalogs and literature review. Table 2 presents the constant parameter values of 3D printing.

The 3D printed part, build in this research as a case study, is a tensile test specimen according to ASTM D638.[32] The dimensions of the standard specimen are shown in Figure 2. This research aim is to investigate the tensile strength, elongation, and dimensional error of the printed part. In addition, this research also collects the printing time data. Therefore, the experiment involves 3^2 factorial design with two replications. In total, 18 experiments are conducted to print 18 specimens. The tensile strength value of each specimen is measured by using a Universal Testing Machine, manufactured by GOTECH testing Machines Inc. The dimensional error value is determined based on the accumulation of the difference between the actual and the designed length, width, and thickness of the specimen. The actual length, width, and thickness are measured by using a caliper with 0.01 mm of accuracy. The caliper is also used to measure the final length of the specimen after the break for calculating the elongation value.

Table 3. Experiment result.

Extrusion temperature (°C)	Feed rate (mm/s)	Tensile strength (MPa)	Elongation (%)	Dimensional error (mm)	Printing time (s)
200	15	85.30	0.073	0.2	3963
200	15	88.68	0.012	0.3	3963
200	20	88.22	0.061	0.4	3321
200	20	91.82	0.121	0.2	3321
200	25	93.45	0.152	0.8	2935
200	25	92.77	0.030	0.5	2935
205	15	85.91	0.079	0.5	3963
205	15	88.42	0.163	0.6	3963
205	20	89.52	0.377	0.9	3321
205	20	95.25	0.133	0.4	3321
205	25	93.30	0.097	0.5	2935
205	25	97.67	0.218	0.2	2935
210	15	101.51	0.426	0.8	3963
210	15	95.92	0.243	0.6	3963
210	20	93.50	0.061	0.5	3321
210	20	97.37	0.061	0.6	3321
210	25	96.62	0.133	0.6	2935
210	25	95.79	0.316	0.7	2935

Results and discussion

The results of the experiment for each combination of extrusion temperature and feed rate are presented in Table 3. Figure 3 shows the average and the standard deviation (SD) values of tensile strength, elongation, dimensional error, and printing time for each extrusion temperature and feed rate. Higher SD value at a certain variable parameter means that the parameter is more affected by the other variable parameter.

As can be seen in Figure 3, the tensile strength average values of the specimens made of continuous pineapple leaf fiber-reinforced PLA composite vary between 90.04 MPa and 96.78 MPa. Based on the tensile strength measurement of the standard specimens printed using the same extrusion temperature and feed rate, the tensile strength average values of the specimens made of pure PLA for each parameter vary between 81.82 MPa and 89.44 MPa. It indicates that the tensile strength average value of the composite specimen is higher than the average value of the pure PLA specimen for each temperature and feed rate. The tensile strength of the composite specimen is increased because the pineapple leaf fiber as the reinforcement has higher tensile strength value compared to the pure PLA. For that reason, the addition of the reinforcement strengthens the composite. Based on the analysis of variance study shown in Figure 4, which is conducted with a confidence level of 95% and a significance level of $\alpha = 0.05$, it is shown that the tensile strength of the specimen made of continuous pineapple leaf fiber-reinforced PLA composite is significantly influenced by the extrusion temperature. As

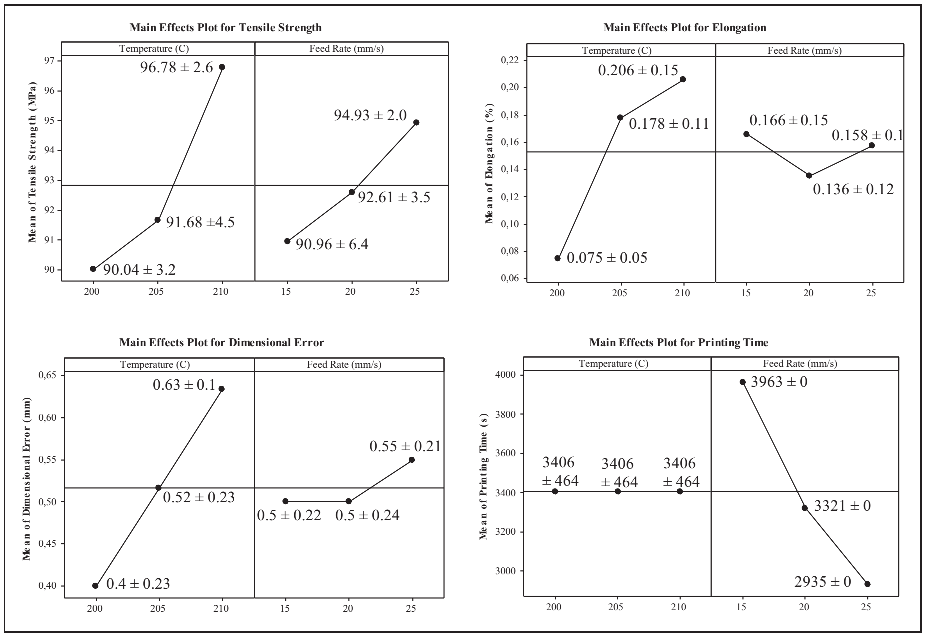

Figure 3. Average and SD values of each property.
SD: standard deviation.

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Temperature	2	148.47	148.47	74.24	7.04	0.008
Feed Rate	2	47.86	47.86	23.93	2.27	0.143
Error	13	136.99	136.99	10.54		
Total	17	333.33				

S=3.24622 R-Sq = 58.90% R-Sq(adj) = 46.26%

Figure 4. ANOVA for yield strength.
ANOVA: analysis of variance.

shown in Figure 3, the higher the extrusion temperature and the feed rate at the experimental range, the higher the tensile strength of the composite specimen.

Figure 3 also shows that the elongation average values of the specimens made of the continuous pineapple leaf fiber-reinforced PLA composite vary between 0.075% and 0.206%. Based on the elongation measurement of the standard specimens printed using the same extrusion temperature and feed rate, the elongation average values of the specimens made of pure PLA for each parameter vary between 0.097% and 0.283%. Therefore, the elongation average value of the composite specimen is lower than the average value of the pure PLA specimen. The reduction of the elongation value is caused by the addition of the continuous pineapple leaf fiber that has lower elongation value compared to the pure PLA. According to Cho et al., the elongation of pure PLA could reach 6%.[33] The elongation of the composite specimen is much lower than pure PLA because of the anisotropic characteristics of the printed specimen. Figure 3 reveals that the increase in the extrusion temperature increases the elongation of the composite specimen. The elongation value increases because higher extrusion temperature increases the diffusion among the filament layers of the specimen.

Al-Ahmari et al. found that the common FDM systems produce a printed part with a maximum dimensional error of 1 mm.[34] In this research, the dimensional error average values of the specimens made of continuous pineapple leaf fiber-reinforced PLA composite vary between 0.4 mm and 0.63 mm. Therefore, the use of the continuous pineapple leaf fiber as the reinforcement does not worsen the dimensional quality of the composite specimen. Based on the experimental data shown in Figure 3, the increase in the extrusion temperature and feed rate causes an increase in the dimensional error of the composite specimen. The dimensional error increases because the higher temperature composite has a lower viscosity and therefore lower accuracy. However, the use of the maximum extrusion temperature at the experimental range does not cause the dimensional error value of the composite specimen exceeding the maximum value produced by the common FDM printer.

As shown in Figure 3, the extrusion temperature does not have any influence on the printing time. Meanwhile, the printing time decreases as the feed rate increases. As the pineapple leaf fiber is combined with the PLA filament started from the roll feeder through the hotend to the nozzle, the required time to print the composite specimen is the same as the required time to print the pure PLA specimen.

Conclusions

The use of continuous pineapple leaf fiber as the reinforcement of the PLA composite for 3D printing material offers several advantages. First, the composite is environmentally friendly and abundantly available as its constituent materials are renewable. Second, the use of continuous fiber as the reinforcement increases the tensile strength of the composite. The average tensile strength of the composite reaches 96.8 MPa. Third, the maximum average dimensional error of the part made of the composite is 0.63 mm. It means that the use of continuous pineapple leaf fiber does not increase the dimensional error value of the composite part beyond the maximum value of the common FDM printed part. Fourth, the required time to print the composite part is the same as the required time to print the pure PLA part. However, the elongation of the composite part is lower than the pure PLA part. As the increase in the extrusion temperature increases the elongation of the composite part, the temperature needs to be optimized to achieve higher elongation and tensile strength at the upper limit value of dimensional error.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship and/or publication of this article: The author(s) received financial support for the research from the Institute of Research and Community Service, University of Surabaya.

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References

1. Ngo TD, Kashani A, Imbalzano G, et al. Additive manufacturing (3D printing): a review of materials, methods, applications and challenges. *Compos Part B Eng* 2018;143: 172–196.
2. Van DKF, Koga Y, Todoroki A, et al. 3D printing of continuous carbon fibre reinforced thermo-plastic (CFRTP) tensile test specimens. *Open J Compos Mater* 2016; 06(01): 18–27.
3. Ferreira RTL, Amatte IC, Dutra TA, et al. Experimental characterization and micrography of 3D printed PLA and PLA reinforced with short carbon fibers. *Compos Part B Eng* 2017; 124: 88–100.
4. Tekinalp HL, Kunc V, Velez-Garcia GM, et al. Highly oriented carbon fiber-polymer composites via additive manufacturing. *Compos Sci Technol* 2014; 105: 144–150.
5. Ning F, Cong W, Qiu J, et al. Additive manufacturing of carbon fiber reinforced thermoplastic composites using fused deposition modeling. *Compos Part B Eng* 2015; 80: 369–378.
6. Yu T, Zhang Z, Song S, et al. Tensile and flexural behaviors of additively manufactured continuous carbon fiber-reinforced polymer composites. *Compos Struct* 2019; 225: 111147.
7. Yang C, Tian X, Liu T, et al. 3D printing for continuous fiber reinforced thermoplastic composites: mechanism and performance. *Rapid Prototyp J* 2017; 23(1): 209–215.
8. El Magri A, El Mabrouk K, Vaudreuil S, et al. Mechanical properties of CF-reinforced PLA parts manufactured by fused deposition modeling. *J Thermoplast Compos Mater*. Epub ahead of print 12 May 2019. DOI: 10.1177/0892705719847244.
9. Wang F, Zhang Z, Ning F, et al. A mechanistic model for tensile property of continuous carbon fiber reinforced plastic composites built by fused filament fabrication. *Addit Manuf* 2020; 32: 101102.
10. Ahmed SW, Hussain G, Al-Ghamdi KA, et al. Mechanical properties of an additive manufactured CF-PLA/ABS hybrid composite sheet. *J Thermoplast Compos Mater* 2019. Epub ahead of print 19 August 2019. DOI: 10.1177/0892705719869407.
11. Imeri A and Fidan I. *Fatigue behaviors of fiber-reinforced composite 3D printing. 2nd ed. Fatigue life prediction of composites and composite structures*. Amsterdam: Elsevier Ltd, 2020, pp. 335–348.
12. Naranjo-Lozada J, Ahuett-Garza H, Orta-Castañón P, et al. Tensile properties and failure behavior of chopped and continuous carbon fiber composites produced by additive manufacturing. *Addit Manuf* 2019; 26: 227–241.
13. Ochi S. Flexural properties of long bamboo fiber/PLA composites. *Open J Compos Mater* 2015; 05(03): 70–78.
14. Chandramohan D and Presin Kumar AJ. Experimental data on the properties of natural fiber particle reinforced polymer composite material. *Data Br* 2017; 13: 460–468.

15. Ahmad MN, Wahid MK, Maidin NA, et al. Mechanical characteristics of oil palm fiber reinforced thermoplastics as filament for fused deposition modeling (FDM). *Adv Manuf* 2020; 8(1): 72–81.
16. Singh R, Kumar R and Ranjan N. Sustainability of recycled ABS and PA6 by banana fiber reinforcement: thermal, mechanical and morphological properties. *J Inst Eng Ser C* 2019; 100(2): 351–360.
17. Tajvidi M, Falk RH and Hermanson JC. Effect of natural fibers on thermal and mechanical properties of natural fiber polypropylene composites studied by dynamic mechanical analysis. *J Appl Polym Sci* 2006; 101(6): 4341–4349.
18. Saba N, Paridah MT and Jawaid M. Mechanical properties of kenaf fibre reinforced polymer composite: a review. *Constr Build Mater* 2015; 76: 87–96.
19. Arib RMN, Sapuan SM, Ahmad MMHM, et al. Mechanical properties of pineapple leaf fibre reinforced polypropylene composites. *Mater Des* 2006; 27(5): 391–396.
20. Jagadish, Rajakumaran M and Ray A. Investigation on mechanical properties of pineapple leaf-based short fiber-reinforced polymer composite from selected Indian (northeastern part) cultivars. *J Thermoplast Compos Mater* 2020; 33(3): 324–342.
21. Elanchezhian C, Ramnath BV, Ramakrishnan G, et al. Review on mechanical properties of natural fiber composites. *Mater Today Proc* 2018; 5(1): 1785–1790.
22. Ku H, Wang H, Pattarachaiyakoop N, et al. A review on the tensile properties of natural fiber reinforced polymer composites. *Compos Part B Eng*. 2011;42(4):856–873.
23. Sanjay MR, Madhu P, Jawaid M, et al. Characterization and properties of natural fiber polymer composites: a comprehensive review. *J Clean Prod* 2018; 172: 566–581.
24. Mazzanti V, Malagutti L and Mollica F. FDM 3D printing of polymers containing natural fillers: a review of their mechanical properties. *Polymers (Basel)* 2019; 11(7): 1094.
25. Balla VK, Kate KH, Satyavolu J, et al. Additive manufacturing of natural fiber reinforced polymer composites: processing and prospects. *Compos Part B Eng* 2019; 174: 106956.
26. Parandoush P and Lin D. A review on additive manufacturing of polymer-fiber composites. *Compos Struct*. 2017; 182: 36–53.
27. Matsuzaki R, Ueda M, Namiki M, et al. Three-dimensional printing of continuous-fiber composites by in-nozzle impregnation. *Sci Rep* 2016; 6: 1–7.
28. Namiki M, Ueda M, Todoroki A, et al. 3D printing of continuous fiber reinforced plastic. *Int SAMPE Tech Conf* 2014; 2014: 2–7.
29. Tian X, Liu T, Yang C, et al. Interface and performance of 3D printed continuous carbon fiber reinforced PLA composites. *Compos Part A Appl Sci Manuf* 2016; 88: 198–205.
30. Harris M, Potgieter J, Archer R, et al. Effect of material and process specific factors on the strength of printed parts in fused filament fabrication: a review of recent developments. *Materials (Basel)* 2019; 12(10): 1664.
31. Suteja TJ and Soesanti A. Mechanical properties of 3D printed polylactic acid product for various infill design parameters: a review. Paper presented at: *International conference on science and technology*, Surabaya, 17–18 October 2019.
32. ASTM International. *ASTM D638-14: Standard test method for tensile properties of plastics*. West Conshohocken: ASTM International, 2014.
33. Cho EE, Hein HH, Lynn Z, et al. Investigation on influence of infill pattern and layer thickness on mechanical strength of PLA material in 3D printing technology. *J Eng Sci Res* 2019; 3(2): 27–37.
34. Al-Ahmari A, Ashfaq M, Mian SH, et al. Evaluation of additive manufacturing technologies for dimensional and geometric accuracy. *Int J Mater Prod Technol* 2019; 58(2–3): 129–154.

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SUBJECT AREA AND CATEGORY

Materials Science
- Ceramics and Composites

Physics and Astronomy
- Condensed Matter Physics

PUBLISHER

SAGE Publications Ltd

H-INDEX

51

PUBLICATION TYPE

Journals

ISSN

15307980, 08927057

COVERAGE

1988-2022

INFORMATION

Homepage

How to publish in this journal

gillespie@ccm.udel.edu

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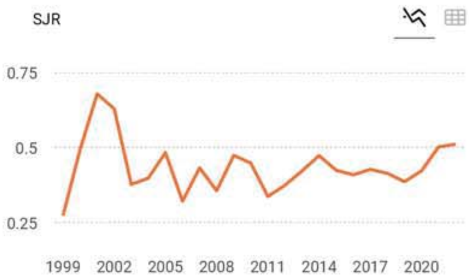

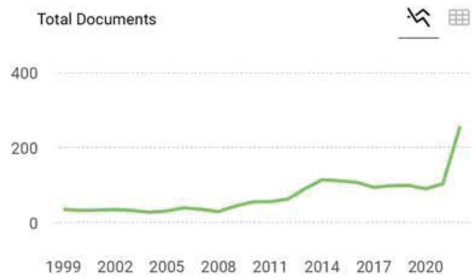

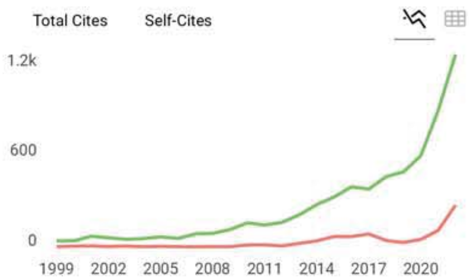

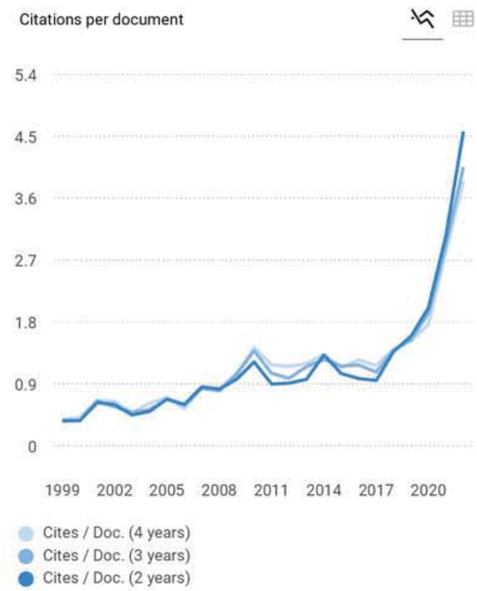

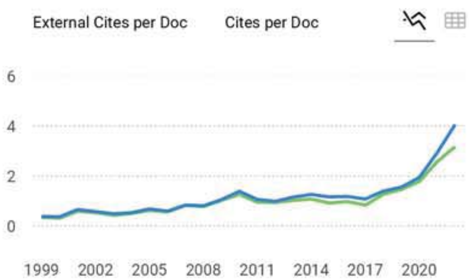

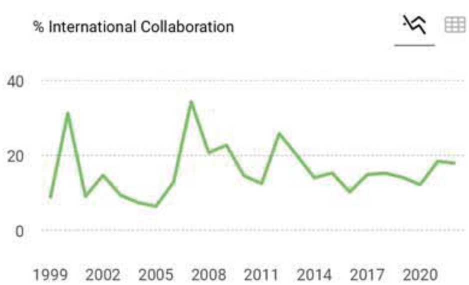

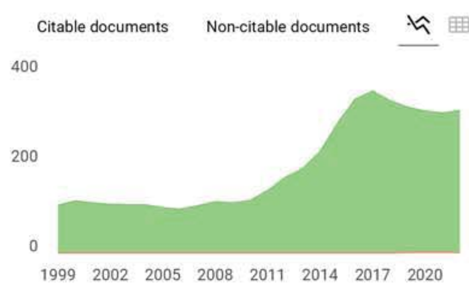

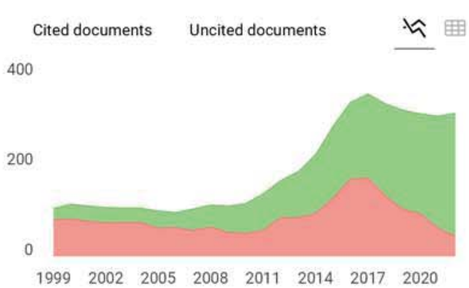

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Scopus coverage years: from 1988 to Present

Publisher: SAGE

ISSN: 0892-7057 E-ISSN: 1530-7980

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