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Mechanical and Thermal Properties of 3D Printed Polylactic Acid Reinforced Alkaline Lignin with Epoxidized Palm Oil Bio-Composites

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Abstract
Fused deposition modeling (FDM), through 3D printing has an advantage of using thermoplastic polymers for fabrication of natural fiber reinforced composites (NFRC). Polylactic acid (PLA) is an extensively used thermoplastic in 3D printing application for its compatibility with the processing parameters. However, the uses of unfilled PLA will produce 3D printed parts with high brittleness, hence reinforcement with lignin from oil palm empty fruit bunches (OPEFB) was considered. Lignin, one of the major components in plant, was less utilized even though contains high aromatic compound that is crucial in the polymer industry. The effect of reinforcement capability of alkaline treated lignin in PLA matrix for fabrication of sustainable 3D printing material was studied where, the obtained alkaline lignin was reinforced in the PLA with various compositions (1, 3 and 5 phr). It has been found that the presence of lignin in the PLA improved the thermal properties as well as the mechanical properties of the PLA bio-composites. Nevertheless, addition of higher lignin load of more than 1 phr contributed to lower thermal and mechanical properties. Better thermal properties were found with addition of EPO, where the maximum degradation temperature and glass transition temperature of PLA bio-composite filaments (PLAE1) have been improved to 335 °C and 59 °C, respectively, instead of 330 °C and 62 °C for unfilled PLA. © 2023, The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd.

Author Keywords
3D Printing; Alkaline lignin; Fused deposition modeling; Polylactic acid

Index Keywords
Fiber reinforced plastics, Fracture mechanics, Fused Deposition Modeling, Glass transition, Lignin, Palm oil, Thermodynamic properties; 3-D printing, 3D-printing, Alkaline lignin, Alkalines, Biocomposite, Mechanical and thermal properties, Natural fibre-reinforced composites, Polylactic acid, Printing applications, Thermoplastic polymer; Deposition; Composites, Deposition, Oil, Printing, Reinforcement, Thermal Properties

References

- Zhang, S., Li, M., Hao, N., Ragauskas, A.J.
  Stereolithography 3D printing of lignin-reinforced composites with enhanced mechanical properties
  (2019) *ACS Omega*, 4 (23), pp. 1-8.
- Chio, C., Sain, M., Qin, W.
  Lignin utilization: A review of lignin depolymerization from various aspects
  (2019) *Renew Sustain Energy Rev*, 107, pp. 232-249.
- Abd Rahman, N.A., Anuar, H., Nordin, N.M., Asri, S.E.A.M., Ali, F., Suhr, J.
  Mechanical and thermal properties of polylactic acid filled lignin powder biocomposite filaments with epoxidized palm oil for sustainable 3D printing application
  (2021) *Perintis Ejournal*, 11 (1), pp. 23-39.
- Pairon, M.S., Ali, F., Ahmad, F., Anuar, H., Abdul Rahman, N.A., Saeed Mirghani, M.E., Suhr, J., Thomas, S.
  Review on solvent extraction methods of lignin from oil palm empty fruit bunches

(OPEFB)
(2022) *J Nat Fibers*, 1 (17), pp. 1-18.

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