E-ISSN: 2829-7687
Journal of Fibers and Polymer Composites
Vol. 5 No. 2 (2026): 230-232

The Next Generation of Sustainable Composites: From High Performance to High Impact

Nasmi Herlina Sari [a,*], Muhammad Nabil Fadhlurrohman Rivlan [a], Edi Syafri [b]

[a] Department of Mechanical Engineering, Faculty of Engineering, University of Mataram, Mataram, Indonesia
[b] Department of Agricultural and Computer Engineering, Politeknik Pertanian Negeri Payakumbuh, West Sumatra, Indonesia

Composite materials have long been recognised for their remarkable strength-to-weight ratio, durability, and design flexibility, allowing their widespread usage in the aerospace, automotive, building, marine, and renewable energy sectors [1]. Traditionally, research has concentrated on improving mechanical performance through upgraded reinforcements, tailored polymer matrices, and better manufacturing procedures. While these breakthroughs have considerably enlarged the potential of composite materials, the goals of composite research are continuously changing [2,3]. The next generation of composites is projected to give more than just greater mechanical qualities, driven by the worldwide goal of zero emissions, circular economy principles, and resource-efficient manufacturing [4].

Today, the value of composite materials is increasingly measured by their environmental performance, recyclability, renewable ingredients, and potential to cut carbon emissions throughout their life cycle [5,6]. As a consequence, sustainable composites reinforced with natural fibers, bio-based materials, and recyclable polymers appear to be potential options for future engineering applications.

Despite this development, transferring laboratory-scale breakthroughs into industrial products remains a substantial issue. Material variability, production scalability, cost competitiveness, and long-term dependability continue to impede the broad implementation of many sustainable composite systems [4,7]. Addressing these difficulties demands closer collaboration between academia and industry, aided by developments in digital manufacturing, artificial intelligence, and life cycle assessment to speed material development while assuring environmental and economic sustainability [6,7].

The future of composite materials will be defined not just by higher strength or reduced weight, but also by their ability to have a significant impact on industry, society, and the environment. The transition from high performance to high impact is a novel approach in composite engineering, with innovation judged by its contribution to sustainable growth, industrial

https://doi.org/10.55043/jfpc.v5i2.710
Received July 31, 2026; Received in revised form July 31, 2026; Accepted July 31, 2026; Published July 31, 2026
* Corresponding author
Email: n.herlinasari@unram.ac.id *

application, and global resilience. By adopting this perspective, sustainable composites will continue to play an important role in designing the future generation of engineered materials [5].

References

[1] Herlina N, Anas H, Amrullah A, Mahardika M. Enhanced mechanical and thermal performance of Paederia foetida fiber-magnesium / epoxy composites : A sustainable solution for automotive and aerospace industries. Case Stud Chem Environ Eng 2025;11:101077. https://doi.org/10.1016/j.cscee.2024.101077.

[2] Thyavihalli Girijappa YG, Mavinkere Rangappa S, Parameswaranpillai J, Siengchin S. Natural Fibers as Sustainable and Renewable Resource for Development of Eco-Friendly Composites: A Comprehensive Review. Front Mater 2019;6:1–14. https://doi.org/10.3389/fmats.2019.00226.

[3] Hubbe MA. Sustainable Composites: A Review with Critical Questions to Guide Future Initiatives. Sustain 2023;15:1–18. https://doi.org/10.3390/su151411088.

[4] Munimathan A, Muthu K, Subramani S, Rajendran S. Environmental behaviour of synthetic and natural fibre reinforced composites: A review. Adv Mech Eng 2024;16:1–19. https://doi.org/10.1177/16878132241286020.

[5] Shanmugam V, Mensah RA, Försth M, Sas GB, Restás A, Addy C, *et al.* Circular economy in biocomposite development: State-of-the-art, challenges and emerging trends. Compos Part C Open Access 2021;5:100138. https://doi.org/10.1016/j.jcomc.2021.100138.

[6] Kirschnick U, Dissanayake N, Zeller V, Saadé M. Life cycle assessment research and industrial reality in the composites sector: A systematic review. Compos Part A Appl Sci Manuf 2026;209. https://doi.org/10.1016/j.compositesa.2026.109985.

[7] Chowdhury MIS, Nahar MN, Mojumder AH, Taimoor I, Salsabil Z, Rahman MZ. Life cycle assessment in natural fiber and hybrid polymer composites: A scopus-based bibliometric and science-mapping analysis. Mater Today Commun 2026;53:115404. https://doi.org/10.1016/j.mtcomm.2026.115404.

BIOGRAPHY

Prof. Dr. Nasmi Herlina Sari, ST., MT

Muhammad Nabil Fadhlurrohman Rivlan

Prof. Dr. Edi Syafri, ST., MSi.