ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul588

Composites Manufacturing and Plastics Processing

Maaz Bahauddin Naveed[1]

[1]Al Qaryan Group

Publication Date: 2026/07/21

Abstract: This Editorial introduces the Special Issue "Advanced Composites Manufacturing and Plastics Processing," which brings together twenty-five research articles and one technical comment addressing recent progress in the manufacturing of fiber-reinforced composites and the processing of thermoplastic and thermoset polymers. The collected contributions span the hybridization of additive manufacturing with established techniques such as automated tape laying, automated fiber placement, and injection molding; the development of long-fiber-reinforced thermoplastics; advances in fiber, yarn, and textile-based reinforcement processing; and the design of bio-based and recycled composite systems. Additional contributions examine the machining, milling, and drilling of polymer and composite laminates, including the use of machine-learning-based predictive models, as well as the functionalization and compounding of polymers for antimicrobial, barrier, thermal, and mechanical performance. Collectively, the papers in this issue illustrate an industry-wide shift toward manufacturing routes that reduce carbon footprint, extend the use of recycled and bio-based feedstocks, and improve process efficiency and part performance through the integration of complementary technologies.

How to Cite: Maaz Bahauddin Naveed (2026) Composites Manufacturing and Plastics Processing. *International Journal of Innovative Science and Research Technology*, 11(7), 573-577. https://doi.org/10.38124/ijisrt/26jul588

I. INTRODUCTION

Technologies, energy issues, and climate change are all influencing the composites and plastics industries. As production processes and systems adjust to these challenges, more and more components with reduced carbon footprints, greater versatility, lower costs, and higher performance are being made. Everything related to making composites and processing polymers is heading in this direction. Injection moulding, foaming, coating, automated lay-up, filament winding, prepreg technologies, injection moulding, foaming, joining, autoclaves, and preforming of textile reinforcements are all technologies that fall under this category. Compression moulding, over-molding/back-molding, blow moulding, thermoforming, rotational moulding, and additive manufacturing/3D printing are all subsets of these technologies.

There are twenty-five main research publications and one technical comment included in this subject. These pieces explain novel approaches of manufacturing composites and polymers. All kinds of polymers are discussed in these articles, along with a plethora of other subjects like modelling, simulations, and novel manufacturing process development, control, performance, and application.

II. ADVANCED COMPOSITES MANUFACTURING

➢ *Coupling/Hybridization of Processes*

Hirschetal. [1] detailed processes for producing hybrid fiber-reinforced polyamide composites by integrating automated tape laying (ATL) with fused granular fabrication (FGF), a form of large format additive manufacturing (LFAM) that makes use of granulates instead of semi-finished filaments to achieve more cost- and time-effectiveness. The composite structure, which consisted of six unidirectional tapes reinforced with glass fiber polyamide, increased strength by 60%. The FGF constructions had significantly higher flexural strength and stiffness.

Atzler et al. [2] investigated the overprinting of continuous fiber reinforced laminates. A hybrid system integrating FGF and AFP was built using thermoplastic laminates made of additively generated units. The construction was designed to be highly functional and perform well. Substrate restrictions in extrusion-based overprinting systems were addressed using a proposed solution. By scanning the laminate in three dimensions, the authors were able to change the shape of the additively manufactured part. The 3D print's consistent mechanical properties and layer heights are a result of this. For their study on the interfacial fusion bonding of hybrid torsion-resilient additively manufactured polycarbonate (unreinforced, fibreglass, or carbon fiber reinforced) components, Kizak et al. [3] combined injection molding with additive manufacturing. The torsional strength of injection-molded components was investigated in this work in relation to various build chamber temperatures and surface treatments (e.g., sandpaper, sandblasting, plasma, etc.) employed in additive manufacturing. Their research showed that additive manufacturing relied on surface treatment of injection-molded components and that raising the build chamber temperature to 50 °C improved torsional strength.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul588

By selectively adding carbon fiber reinforced thermoplastics to a multi-material design, Picard et al. [4] created a cost-effective and adaptable technique for composites. The overmolding and unreinforced thermoplastic layers might be processed in tandem thanks to their concept.

To make welding thermoplastic pultruded profiles loaded with continuous glass fiber reinforcement easier, Ebert et al. [5] devised a technique. Even with a 70% fiber volume percentage, high-quality welds to polyamide 6 thermoplastic profiles may be achieved by integrating a line focusing infrared emitter into the conventional hot-tool line welding process.

➢ *Synthesis of Adhesives and Mechanized Fiber, Yarn, or Tape Application*

Legenstein and Fauster [6] used flash lamp heating technology as part of the ATP process to maximize the interlaminar adhesive bond strength on thermoplastic carbon fiber tape. Modern, laser-assisted automated tape placement systems provide a wonderful balance between low price, high concentration of energy, and safety.

Automated tack, decay, and peel tests were created by Shi et al. [7] as a component of their research on automated tape laying. The degradation of prepreg tape tack at different temperatures was assessed using a newly devised decay test. Prepreg tack degradation testing was created. A new statistical unit of tack connected to the remaining material shelf life and a methodology to lower prepreg inventory shelf life expenses were introduced in this paper.

Knoche et al. [8] described the novel direct insertion method for inserting continuous impregnated carbon fiber tows and pointed out its drawbacks. Such a study had never been conducted before. Following a discussion of the benefits and drawbacks of their direct placement method, the authors arrived at the equations of motion.

Carbon fiber reinforced PAEK, the quick LFAM method, and slow crystallizing PAEK were all utilized in the investigation conducted by Consul et al. [9]. The authors' thorough investigation demonstrated the effects of line width, layer height, extrusion temperature, and layer build time on the mechanical properties of the printed components. To find out how the printing process impacted the printed components, the researchers used infrared cameras and thermocouples to examine the temperature histories of the parts.

They reasoned that the mechanical performance of the parts may be enhanced by optimizing the shear rate and enthalpy deposition rate below the nozzle. The authors went on to state that the standard practice of allocating set layer durations does not ensure consistent quality in the final products.

Using recycled continuous carbon fiber (cCF) composites comprised of polypropylene (PP) and polyamide (PA), Baddour et al. [10] devised unique prepregnation and fused filament manufacturing parameters. After manufacture, the components were annealed and the cCF was plasma treated to evaluate the effects on the materials' flexural properties. The process of creating cCF composites was also extensively discussed.

3D printed aeronautical designs and screw extrusion molds and preforms were made from carbon fiber reinforced polyamide by Antolin-Urbaneja et al. [11]. They used a mix of experimental characterisation and multi-physics modeling to achieve this. Not only is the built mold 90% lighter than the original Invar mold, but it also satisfies all mechanical and thermal design requirements.

➢ *Develop LFTs*

The mechanical properties of long fiber reinforced thermoplastic composites were found to be enhanced when a PP-g-MAH was used, as demonstrated by Tipboonsri and Memon [12]. Moreover, it was found that the modified composites' mechanical properties were substantially improved at a concentration of 4% additive.

➢ *When it comes to Making Things out of Fiber and Cloth,*

As part of their groundbreaking fiber sizing line, Semitekolos et al. [13] conduct a pilot research on process parameters and functional size design before cutting and selecting several sizing solutions. Additionally, carbon nano-materials are utilized in these studies, although the focus is on the effects of different concentrations and surface functionalizations on the mechanical properties and surface morphology of carbon fabrics. When carbon nanotubes and few-layer graphene functionalized with N2-plasma were added, the interfacial shear strength (ISS) increased by an astounding 90%.

There are several potential applications for the carding process beyond the integration of thermoplastic fibers; nevertheless, Ivars et al. [14] demonstrated using a Weibull statistical approach that the mechanical property uniformity of carded rCF webs was improved by carding crimped thermoplastic polypropylene (PP) fibers.

➢ *How Bio-Based Composites will Serve their Users in the Future*

The crystallinity and, consequently, the flexural and impact properties of compression moulded flax (PLLA) biocomposites were studied by Pisupati et al. [15] in relation to different cooling speeds. Biocomposites containing 40 wt.% flax fiber increased the flexural modulus by 25% and those containing 50 wt.% flax fiber increased it by 100%, according to the results. A possible semi-structural role for the flax/PLA composites was shown by the decreased cooling rates.

Using a combination of hot pressing and injection molding, Li et al. [16] investigated two PP composite systems that were reinforced with coconut fiber. Composites made using the multilayer hot-pressing technique have exceptional mechanical qualities that find use in a wide range of industries.

To replicate the HIC for a person hit by a tram rail vehicle, Jeong et al. [17] presented a model made of polyvinyl butyral (PVB) laminated glass. This study introduces a new model that facilitates the integration of PVB films and tempered glass into one shell element, as an alternative to the usual PLC approach. The model does not attempt to recreate the complete multi-tier design of PVB-laminated glass; instead, it accounts for the multi-layered structure through integration points. When compared to the PLC model, which takes eight hours to provide equal results, the equivalent model can do so in just one hour because to analytical equivalency. This is the case even when the two models are executed simultaneously in the same setting using identical software and hardware, all with the same objective.

III. MACHINING, MILLING, AND DRILLING OF POLYMERS, COMPOSITES, AND MULTI-MATERIAL LAMINATES

Nargis et al. [18] developed solutions for improving the drilling quality of carbon polymer composites with fiber reinforcement, nanocomposites made of alumina and hybrid SiC and silicon carbide. The goal of developing these technologies was to enhance the quality of the drilling process. Step, core, and twist drills were the three types that were utilized. We built surface roughness prediction models based on ANN and RF techniques after investigating the surface roughness of drilled holes using the response surface methodology (RSM) and a few statistical methodologies. Both models showed a great deal of predictive potential. Out of the three models that were assessed, the random forest model performed the best, followed by the ANN model and the RSM model.

Carbon fiber reinforced aluminum laminates' helical drilling and helix milling processes were modeled by Bolar et al. [19]. These techniques were employed in the construction of the buildings. Laminates constructed of fiber metal are not easily cut by machines. Producing holes with a smooth surface is best accomplished with the helical milling process.

To determine how cryogenic machining affected the surface roughness of polymethyl methacrylate, Wu et al. [20] used Single Point Diamond Turning (SPDT). Cryogenic machining of PMMA yields a polymer that serves the research aimr.

IV. POLYMER PROCESSING AND COMPOUNDING

➢ *Functionalization*

The polymer nanocomposite of amine-modified nanoclay and antimicrobial polyamide 6 was created by Andrade-Guel et al. [21] using melt-blowing and can be used to create adsorbent non-woven fabrics with antibacterial properties.

Blowing linear low-density polyethylene (LLDPE) bottles have gas barrier, mechanical, bactericidal, and thermal qualities, as pointed out by Alkarri et al. [22]. Two new methods for heat embossing antimicrobial particles onto bottle surfaces were suggested by the authors. These techniques involved coating the inside of the mold using a novel approach of spray and powder deposition. Both methods improved the antimicrobial and barrier functions of the bottles without altering their thermal or mechanical stability.

Researchers Prihandana et al. [23] looked at how different sized activated carbon (AC) particles affected the protein-separation permeability of polysulfone composite membranes. Researchers constructed membranes with variable AC loadings via phase inversion, with water serving as the coagulant. The AC loadings varied in size. Researchers looked at how several parameters such as AC particle size correlated with things like membrane geometry, porosity, average pore size, molecular weight cutoff, water flux through the system, and the ability to reject proteins. In order to separate proteins using polysulfone membranes, the scientists also provide instructions on how to choose the right size of AC particles.

The strength of g-C3N4-epoxy thermosets was studied by Al Mais et al. [24] in relation to changes in particle size and thermal properties. They found that a weight percent of 0.5 was the sweet spot for bulk g-C3N4 performance. The tensile strength of composites increased by fourteen percent. g-C3N4 improved heat resistance and lengthened product life. At temperatures exceeding 600 ◦C, G-C3N4 composites exhibited thermal deterioration and a 17% rise in the glass transition temperature (Tg).

The possibility of producing PP-based compounds for automotive application was investigated by Gall et al. [25] by combining packaging recyclates with ELVs. Two different ELV recyclates grades made from recycled bumpers were compared to a packaging-based PCR. In order to increase the strength of the recycled materials, a tiny quantity of minerals and virgin polypropylene were incorporated. The flowability of the PCR compounds could be better, but they are nearly there in terms of their objective mechanical properties.

Mathematical and thermal characteristics of post-consumer recycled graphene-modified high-density/high-viscosity polyethylene blends were investigated by Kharmoudi et al. [26]. Researchers have found that by adding a little amount of graphene to recycled polyethylene, they can create rainwater drainage pipes with mechanical properties and fracture propagation resistance that are almost comparable to those of virgin polyethylene without modification.

V. CONCLUSION

Taken together, the contributions gathered in this Special Issue point to several converging trends in composites manufacturing and plastics processing. First, the boundary between additive manufacturing and conventional composite fabrication routes is becoming increasingly blurred, with several papers demonstrating hybrid systems that couple fused granular fabrication or fused filament fabrication with automated tape laying, automated fiber

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul588

placement, or injection molding to combine the design freedom of 3D printing with the mechanical performance of established processes.

Second, sustainability considerations are driving much of the reported work, whether through the use of recycled carbon fiber and post-consumer recycled polyolefins, the substitution of packaging-grade or end-of-life-vehicle recyclates for virgin polymer, or the development of bio-based flax/PLA and coconut-fiber-reinforced systems as alternatives to conventional reinforcements. Third, process monitoring and predictive modelling are playing a growing role in quality assurance, as illustrated by the machine-learning-based surface roughness models for drilling operations and the thermal imaging methods used to track additive manufacturing builds in real time.

Finally, functionalization of polymers and composites for antimicrobial, barrier, thermal, and interfacial performance continues to expand the range of applications addressed, from packaging and filtration membranes to structural and semi-structural composite parts. Collectively, these twenty-five research articles and one technical comment illustrate that advances in composites manufacturing and plastics processing are increasingly shaped by the joint pursuit of lower carbon footprint, higher process efficiency, and improved part performance, and they point toward continued integration of additive, subtractive, and conventional processing technologies in future work.

REFERENCES

[1]. Hirsch, P.; Scholz, S.; Borowitza, B.; Vyhnal, M.; Schlimper, R.; Zscheyge, M.; Kotera, O.; Stipkova, M.; Scholz, S. Processing and Analysis of Hybrid Fiber-Reinforced Polyamide Composite Structures Made by Fused Granular Fabrication and Automated Tape Laying. *J. Manuf. Mater. Process.* 2024, *8*, 25. [CrossRef]

[2]. Atzler, F.; Hümbert, S.; Voggenreiter, H. A Workflow for the Compensation of Substrate Defects When Overprinting in Extrusion-

[3]. Based Processes. *J. Manuf. Mater. Process.* 2024, *8*, 147. [CrossRef]

[4]. Kizak, M.; von Bartschikowski, A.; Trauth, A.; Heigl, C.; Drechsler, K. Investigation of the Interfacial Fusion Bonding on Hybrid Additively Manufactured Components under Torsional Load. *Polymers* 2024, *16*, 2719. [CrossRef]

[5]. Picard, P.K.W.; Osswald, T.A.; Zaremba, S.; Drechsler, K. Modeling of a Process Window for Tailored Reinforcements in Overmolding Processes. *J. Compos. Sci.* 2024, *8*, 65. [CrossRef]

[6]. Ebert, C.; Dürr, M.N.; Bonten, C. Functionalization of Continuous Fiber-Reinforced Thermoplastic Pultrusion Profiles by Welding.

[7]. *J. Compos. Sci.* 2025, *9*, 6. [CrossRef]

[8]. Legenstein, A.; Fauster, E. Effect of Flashlamp Heating System Parameters on the Wedge Peel Strength of Thermoplastic Carbon Fiber Tape in the Automated Tape Placement Process. *J. Manuf. Mater. Process.* 2024, *8*, 91. [CrossRef]

[9]. Shi, J.; Wang, W.; Wang, Y.; Qi, J.; Xiao, J. A Peel Test Method to Characterize the Decay Law of Prepreg Tape Tack at Different Temperatures. *Materials* 2024, *17*, 2449. [CrossRef]

[10]. Knoch, E.; Rittner, S.; Holschemacher, K. Analysis and Modeling of the System Boundaries of a High-Speed Direct-Yarn-Placement System for In Situ Impregnation of Carbon Fibre Heavy Tows as Textile Reinforcements for Concrete Parts. *Fibers* 2024, *12*, 47. [CrossRef]

[11]. Consul, P.; Feuchtgruber, M.; Bauer, B.; Drechsler, K. Influence of Extrusion Parameters on the Mechanical Properties of Slow Crystallizing Carbon Fiber-Reinforced PAEK in Large Format Additive Manufacturing. *Polymers* 2024, *16*, 2364. [CrossRef]

[12]. Baddour, M.; Garcia-Campà, R.; Reyes, P.; D'hooge, D.R.; Cardon, L.; Edeleva, M. Designing Prepregnation and Fused Filament Fabrication Parameters for Recycled PP- and PA-Based Continuous Carbon Fiber Composites. *Materials* 2024, *17*, 1788. [CrossRef]

[13]. Antolin-Urbaneja, J.C.; Vallejo Artola, H.; Bellvert Rios, E.; Gayoso Lopez, J.; Hernández Vicente, J.I.; Luengo Pizarro, A.I. Experimental Characterization of Screw-Extruded Carbon Fibre-Reinforced Polyamide: Design for Aeronautical Mould Preforms with Multiphysics Computational Guidance. *J. Manuf. Mater. Process.* 2024, *8*, 34. [CrossRef]

[14]. Tipboonsri, P.; Memon, A. The Impact of PP-g-MAH on Mechanical Properties of Injection Molding of Long Glass

[15]. Fiber/Polypropylene Pellets from Thermoplastic Pultrusion Process. *J. Manuf. Mater. Process.* 2024, *8*, 53. [CrossRef]

[16]. Semitekolos, D.; Papadopoulos, I.; Anagnou, S.; Dashtbozorg, B.; Li, X.; Dong, H.; Charitidis, C.A. Nanomaterial-Enhanced Sizings: Design and Optimisation of a Pilot-Scale Fibre Sizing Line. *Fibers* 2024, *12*, 16. [CrossRef]

[17]. Ivars, J.; Labanieh, A.R.; Soulat, D. Influence of the Thermoplastic Fiber Ratio on the Mechanical Properties of Recycled Carbon Fibers During the Carding Process. *Materials* 2025, *18*, 302. [CrossRef] [PubMed]

[18]. Pisupati, A.; Curto, M.; Laurent, T.; Cosson, B.; Park, C.H.; Dhakal, H.N. Influence of Cooling Rate on the Flexural and Impact Properties of Compression Molded Non-Woven Flax/PLA Biocomposites. *Polymers* 2025, *17*, 493. [CrossRef] [PubMed]

[19]. Li, J.; Zhou, Y.; Chen, J.; Hu, H.; Sun, M. A Comparative Study of Airbag Covers for Automotive Safety Using Coconut Shell Fiber/PP Composite Materials. *J. Compos. Sci.* 2024, *8*, 328. [CrossRef]

[20]. Jeong, Y.; Jeon, Y.; Lee, W.; Yoon, J. Development of an Equivalent Analysis Model of PVB Laminated Glass for TRAM Crash Safety Analysis. *Polymers* 2025, *17*, 25. [CrossRef]

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul588

[21]. Nargis, T.; Shahabaz, S.M.; Acharya, S.; Shetty, N.; Malghan, R.L.; Shetty, S.D. A Comprehensive Study on the Optimization of Drilling Performance in Hybrid Nano-Composites and Neat CFRP Composites Using Statistical and Machine Learning Approaches. *J. Manuf. Mater. Process.* 2024, *8*, 67. [CrossRef]

[22]. Bolar, G.; Dinesh, A.A.; Polishetty, A.; Shetty, R.; Hiremath, A.; Neelakantha, V.L. Performance Analysis of Helical Milling and

[23]. Drilling Operations While Machining Carbon Fiber-Reinforced Aluminum Laminates. *J. Manuf. Mater. Process.* 2024, *8*, 113. [CrossRef]

[24]. Wu, X.; Kang, Q.; Jiang, X.; Fang, X. Machinability and Surface Properties of Cryogenic Poly(methyl methacrylate) Machined via Single-Point Diamond Turning. *Materials* 2024, *17*, 866. [CrossRef]

[25]. Andrade-Guel, M.; Cabello-Alvarado, C.J.; Ávila Orta, C.A.; Cadenas-Pliego, G.; Cruz-Ortiz, B. Functional Technical Textile-Based Polymer Nanocomposites with Adsorbent Properties of Toxins and Dyes also Have Antibacterial Behavior. *Materials* 2024, *17*, 3007. [CrossRef] [PubMed]

[26]. Alkarri, S.; Naveed, M.; Alali, F.; Vachon, J.; Walworth, A.; Vanderberg, A. Anti-Microbial, Thermal, Mechanical, and Gas Barrier Properties of Linear Low-Density Polyethylene Extrusion Blow-Molded Bottles. *Polymers* 2024, *16*, 1914. [CrossRef] [PubMed]

[27]. Prihandana, G.S.; Muthi'ah, A.D.; Sriani, T.; Mahardika, M. The Influence of Activated Carbon Particle Size on the Properties and Performance of Polysulfone Composite Membrane for Protein Separation. *J. Compos. Sci.* 2024, *8*, 483. [CrossRef]