



## Introduction

Fiber-reinforced composites are increasingly being utilized as a material technology across various fields, with a focus on advancing research. This literature review aims to explore both the current applications and ongoing research advancements in fiber-reinforced composites.

## Applications

Aerospace – wings and fuselages

Construction – bridges and pipes

Sports – surfboards and skis

Figure 1: Automotive – Composite coil spring developed for Audi [1]



Figure 2: Energy – Composite high wind turbine [1]

Figure 3: Medical – Composite wheelchair [1]



## Sustainability Efforts for the Future

- Bio-composites through natural plant fibers combined with synthetic fibers. [2]
  - Natural Plant Fibers: bast, fruit, leaf, agro
  - Reduce carbon footprint and other environmental impacts
  - Lighter weight leading to fuel efficiency
  - Better end-of-life and recycling

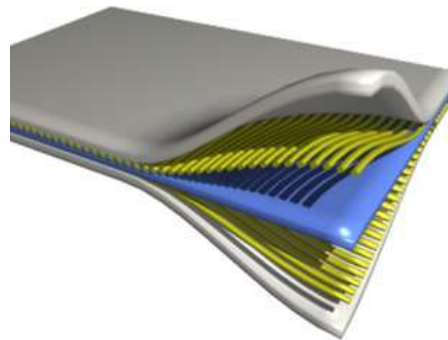


Figure 4: Example of a “typical fiber-reinforced composite” [1]

## Fiber-Reinforced Composites vs. Traditional Materials

Compared to traditional materials, composites combine at least two different types of materials, thereby merging their distinct properties. This process enables the selection of materials to focus on the optimal properties for specific applications. Incorporating fibers into composites further enhances these properties, such as increased load-bearing capacity.

## Influence of Fiber Type on Composite Properties

Glass	
• High durability	
• High strength	
• High electrical resistivity	
• High corrosion resistance	
• Low dielectric constant	
• Alkali resistance	
• Acid corrosion resistance	
• High tensile strength	

Carbon	
• Versatility	
• High durability	
• High strength	
• High stiffness	
• Chemically inert	
• Electrically conductive	
• Infusible	
• High modulus of elasticity	

Kevlar / Aramid	
• High performance	
• Light weight	
• High durability	
• High strength	
• High stiffness	
• Fatigue resistance	
• High impact resistance	
• Low compression strength	

Figure 5: Properties of Different Fiber Types [3]

## Most Common Manufacturing Techniques

### Techniques [1]

- Hand lay-up (most common)
  - By rolling, resin is pushed through the fibrous material, removing any air, and coating the reinforcement material completely.
- Filament Winding (most common for axial symmetric parts)
  - Fibers have resin pushed through by passing through a resin bath. They are then wound on a mandrel dependent on part size.
- Injection Molding (most common for plastics)
  - An extruder blends chopped fibers with resin several times, and final shape is made by a hydraulic or pneumatic press.

## Orientation and Arrangement of Fibers

Orientation of fibers influences the overall performance of the composite through the mechanical strength and load distribution. Incorrect or misaligned fibers can cause defects physically.

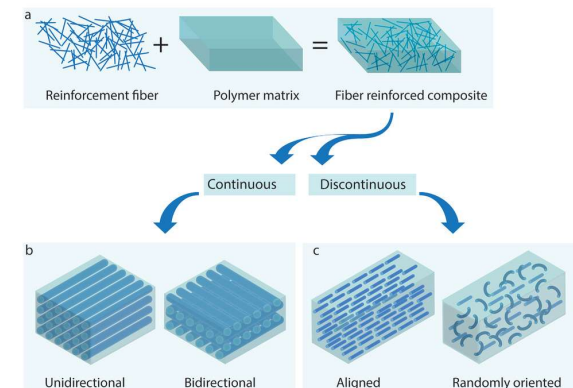


Figure 6: Fiber Orientation [2]

## References

[1] Erden, S., & Ho, K. (2017). Fiber reinforced composites. In *Fiber Technology for Fiber-Reinforced Composites* (pp. 51–79). Elsevier. <https://doi.org/10.1016/B978-0-08-101871-2.00003-5>

[2] Maiti, S., Islam, M. R., Uddin, M. A., Afroj, S., Eichhorn, S. J., & Karim, N. (2022). Sustainable Fiber-Reinforced Composites: A Review. In *Advanced Sustainable Systems* (Vol. 6, Issue 11). John Wiley and Sons Inc. <https://doi.org/10.1002/adsu.202200258>

[3] S. P., K. M., S., K. N., & S. S. (2017). Fiber Reinforced Composites - A Review. *Journal of Material Science & Engineering*, 06(03). <https://doi.org/10.4172/2169-0022.1000341>