

Circular economy in composite materials: the many challenges of a sustainable growth pathway

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Polymer matrix composite materials, with their unique properties such as mechanical strength combined with light weight, resistance to chemical attack, and heat resistance, have penetrated all application areas where high structural and functional performance is required. The aerospace, automotive, construction, and renewable energy sectors, through the use of composite materials, can benefit from weight reduction, improved fuel efficiency, and increased durability, achieving important goals from the perspective of sustainability. However, the production and disposal of these materials pose significant environmental challenges that threaten some of the premises that have become an important motivation for their use today.

The extensive use of raw materials from nonrenewable sources and energy-intensive processes, high waste rates, and limited recycling practices are major brakes. By 2050, wind turbine waste is expected to reach about two million tons globally, a figure equal to the volume of composite material produced by all of Europe in 2020. (1, 2) If we consider wind turbine waste together with end-of-service aircraft waste, the total annual CFRP waste is estimated to be about 840,300 tons. This perspective implies important cost and regulatory framework considerations. The future of composite materials lies in the circular economy. This means to explore alternative low carbon feedstocks, improve the manufacturing efficiency, increase composite lifetime, develop reuse and repair technical and business strategies, design materials and structures designed for recycling, recovery and disposal. All this without sacrificing performance. Companies that proactively embrace the circular economy today will contribute to the environmental sustainability of the composites industry and gain a competitive advantage in the marketplace by offering innovative solutions.