Chair of Carbon Composites
TUM School of Engineering and Design
Technical University of Munich

Green Composites

With lightweight materials towards circular economy

By investigating sustainable raw materials, developing resource efficient processes and recycling strategies, we as TUM LCC contribute to sustainability in the world of composites.

Materials

New sustainable material system are studied in order to integrate them in traditional manufacturing processes as a replacement for conventional ones. These materials include biobased, biodegradable or recycled fibers and polymers. These efforts are aimed at promoting the widespread adoption of sustainable composites across various industries.

Fig. 1: Longboard made with 100% biobased epoxy; flax plate; algae for alternative carbon fiber production [1]

Resource Efficient Processes

Some examples of approaches to reduce the carbon footprint in this area are: Automated manufacturing to minimize processing waste, eliminating energy-intensive processing steps such as autoclave consolidation, optimization of temperature cycles or utilizing heat recovery in processes with energy intensive thermal management.

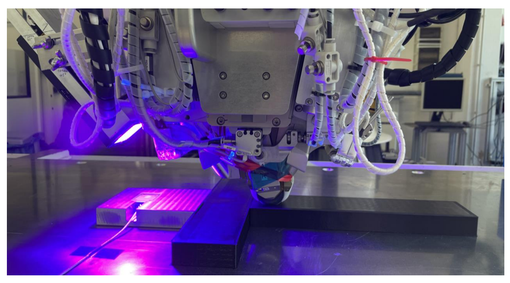

Fig. 2: Resource efficiency through in-line consolidation using UV-curing in automated fiber placement [2]

Sustainable Performance

A key factor in the use of sustainable materials as a replacement for conventional ones is their durability and performance. At the chair we investigate the degradation of their properties and the influence of the use conditions, manufacturing processes and recycling strategy.

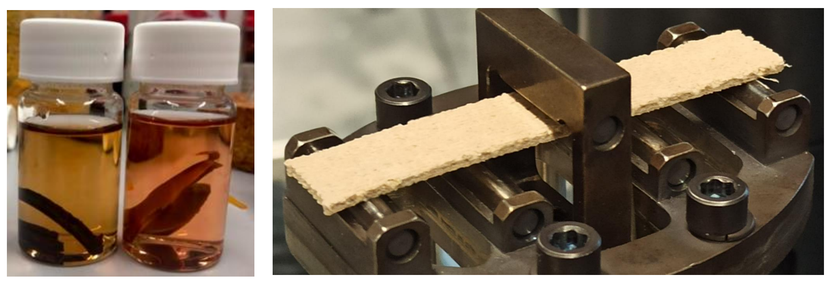

Fig. 3: Chemical, thermal & mechanical characterization of durability or degradation of fibers and matrix

Circularity

The concept of a closed material cycle is becoming increasingly important. To achieve this, it is necessary to explore new down/re/upcycling methods and biodegradable alternatives to ensure that composites can be reused in a new life cycle. Design for recycling of composite applications is also an approach that can contribute to achieving the goal of a closed material cycle.

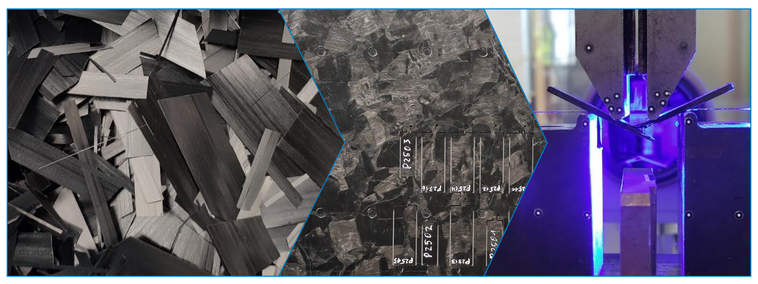

Fig. 4: Remolding of CF-PEEK tape waste to produce high performance long fiber reinforced composites [3]

Life Cycle Assessment

LCAs assess the environmental impacts of composites, encompassing their manufacturing processes, raw materials and usage phase, with the aim of identifying potential for optimization and reduction of greenhouse gas emissions along the entire value chain of fiber-reinforced composites, for both novel and established materials, technologies, and applications.

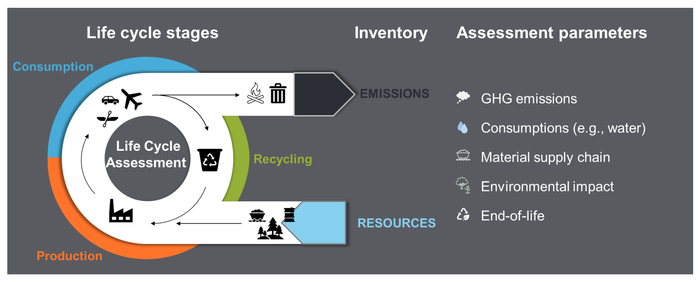

Fig. 5: Scheme of a life cycle assessment for a sustainable composite future

Life Cycle of Green Composites

[1] Stumberger, R.: Algen, der Baustoff der Zukunft? – Forschung an der TU München, Baublatt, 2020
[2] Lu, W.: Parameter study: Investigation of the radiation behavior of an LED-UV-lamp in relation to the Automated Fiber Placement process, Term Project – TUM Chair of Carbon Composites, 2022
[3] Pariyski, S.: Characterization of Compression Moulded CF-PEEK recyclate to Enhance Process Understanding, Master Thesis – TUM Chair of Carbon Composites, 2022

More information and contacts: