

Composites and the circularity advantage

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Luca Gentilini – Cobat Compositi, Volker Mathes – AVK

luca.gentilini@haikiplus.it

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The Worldwide Composites Market - Facts

- Worldwide Composites Market 2024: 13,5 million tons
 - ➢ Increase compared to 2023 (13 million tons) ≈ 4%
 - ➢ Decrease Europe compared to 2023 ≈ -5,6%
- Different regional development: Americas, Asia & Europe
- > 95% of the Reinforcements are Glass Fibres

- Carbon Fibre Reinforced Plastics: Market share of 3 %
- Shortfibre Reinforced Thermoplastics are the biggest market segment
- > Thermosets are still the biggest group in the field of Long- and Endlessfibre systems



The European Composites* Market in kt (2024)

RE





The European Composites* Market (2024) – Market Share Materials





Glass Fibre Reinforcements – Main Material Systems





European GFRP & CFRP Market Development (kt)





European GFRP Market (regions)

RE





European Composites* Market - Applications

RE





European Composites* Market - Applications





European Composites Market – Trends

In February 2025 the respondents of the Composites Germany Market Survey believed that the specified application processes will develop as follows over the next six months :





European Composites Market – Trends

- There are currently numerous challenges & chances, both for the economy in general and for the composites industry in particular, e.g.:
 - High international competition pressure
 - High political uncertainties

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- Economy as a whole is weakening
- Transport, Construction and E&E markets struggle
- Potential growth drivers

- > Renewable Energies as important growth driver (windindustry Europe vs. Asia)
- Sustainability becoming a core topic
- Innovation instead of a price war
- Process optimization & digitalization



Characterization of End-of-Life composite streams















Characterization of End-of-Life composite streams

Composites assembly in wind blades

The overall wind blade structure can be populated by: Multiple types of composites fabrics: the same blade can house unidirectional, biaxial and triaxial fabrics matrixes layers, regardless the material (GF or CF).

Fillers as foam or balsa wood: since composite layers sandwiches cannot be modeled perfectly tracing the final aerodynamic shape of the blade, fillers as foams (for example polyurethane foam) or balsa wood are included in the blade to shape its external surface.

Paint for external coating (and putty): commercial wind blades are coated with a protective painting layer of non-negligible thickness. Bolts and barrel nuts: available at the blade root ring for the bladenacelle joining.

Lightning protection system: a metallic receptor is available on the tip of each wind blade, as it represents a defined point of strike for flashes. An adequately dimensioned copper wire ensures blade grounding, and therefore crosses the whole blade.

Sensors and electronics: most modern wind blades have electronic monitoring systems which then remain in the dismantled blade.



	Material by weight
CF/GF fabric	60.4%
Resin	32.3%
Steel	1.1%
Copper	0.6%
Balsa	2.3%
Foam	1.7%
Paint	0.9%
Putty	0.7%





Characterization of End-of-Life composite streams

Fibers and matrixes in wind blades

Typically, long/endless E-glass fibers are used as main reinforcement in the wind blades. Composites in wind blades have high glass-toresin ration, as they contain up to 75% in weight of glass.

Stronger alternatives to E-glass include: High-performance glass fibers (i.e., S-glass, S2 glass, R-Glass, WindStrandTM glass fibers); Carbon fibers; Aramid and basalt fibers; Hybrid composites (glass and carbon).

Regardless the type and concentration of fibers, thermosets (epoxies, polyesters, vinylesthers) are almost always used as matrixes in wind blade composites.





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Recycling and recovery of composites in Europe

Technology	Output materials	Pros and cons	TRL	Large adoption scalability
Remanufacturin g	Composite sections embedded in smaller products	P: low environmental impact P: cost efficient C: poorly scalable	TRL 8	Pilot examples, poorly scalable
Mechanical recycling	Mechanical recyclingCoarse mixtures: short fibers and fine powders.P: high throughput P: cost efficient C: material downcycling contamination, non- homogeneity		TRL 8	Mid-scale adoption
Co-Processing (Cement Kiln)	P: high throughputessingEnergy recovery andP: cost efficientKiln)cement fillerC: material lossC: additional energy needed		TRL 9	Large scale adoption
Pyrolysis	Long fibers with high residual properties; gases and oils for energy recovery	P: high-added value recovery C: oxidation of recovered fibers C: high processing costs	TRL 7	Scalable to multi- tons capacity
Fluidized bed	Long clean fibers withP: high-added value recoveruidized bedhigh residualP: clean fiberspropertiesC: challenging gasmanagement		TRL 6	Profitability can be reached only with large scale- ups
Chemical recycling	Long fibers with high residual properties; reusable resins	P: recovery of fibers and resins C: high energy and solvents consumption C: gas emissions	TRL 5	Hardly scalable to large applications





Composite product – EoL strategy matchmaking and conclusion

	Market sector	Wind energy	Naval	Aerospace	Auto motive	Construc tion	Sport
technology opportunity	Temperature assisted reshaping		Polyester based composites		Short lifecycle		Short lifecycle
	Reversible adhesives	Reusable layers		Reusable components	Reusable components		Reusable components
	Design for disassembly	Complex assemblies		Complex assemblies		Complex assemblies	
	Laser based dismantling, machining	Multi materials		Multi materials	Multi materials		
	Laser-induced breakdown spectroscopy	Remote testing	Non destructive	Non destructive	Non destructive		Non destructive
vative	Catalyst assisted green solvolysis			CFRPs	CFRPs		CFRPs
Innov	Electro-fragmentation	GFRPs laminates	GFRPs laminates	FRPs laminates	FRPs laminates		FRPs laminates
	Vitrimers, reversible green resins	Potentia	lly applicable	to innovative J	oroducts in no	on-high-tempe	eratures environments
	Smart recognition for sorting Disassembly components						



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