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A new generation of recycled composite materials for sustainable mobility

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Composite materials play a key role in the development of lightweight structures that help reduce vehicle weight. The main advantage of using more lightweight materials is the reduction in CO_2 emissions. However, there are some drawbacks to using these materials, such as the large volume of waste generated during component manufacture, as well as during the incineration or landfill processes of the materials in the end-of-life stage (EoL).

Today, social awareness of climate change is growing. The devastating effects on air quality and, consequently, human health, make it necessary to face new challenges. These include developing new technologies for recycling and reuse as part of design-stage criteria in order to guarantee maximum recyclability of these materials, as well as developing new materials that are easier to recycle.

A Europe-wide recycling plan

To address these challenges, the European Commission has proposed a Circular Economy Action Plan [1], which calls for reducing the amount of waste generated. This can be achieved by transforming it into new, high-quality products, and aims to minimize environmental impact and reduce the carbon footprint.

The main aspects which fuel recycling initiatives are:

- The significant increase in composite material waste,
- Stricter legislation, and
- Social awareness of the need to eliminate practices that encourage landfilling and incineration of materials.

Despite this new trend towards recycling, there are still barriers that limit market access of recycling technology for composite materials:

- ***Environmental legislation:*** Environmental protection is one of the major challenges of the EU's long-term strategy of zero emissions vehicles by 2050 [2]. Furthermore, legislation on waste management and use and environmental impact requires all engineered materials to be properly recovered and recycled at the product's EoL, as in the case of end-of-life vehicles (ELVs). This need is intensified by the use of electric vehicle batteries that extend vehicles' driving range and the use of composite materials that reduce structural weight.
- Both Directive 2000/53/EC [3] on end-of-life vehicles and Directive 2012/19/EU [4] on waste electrical and electronic equipment stipulate that 95% by weight per vehicle should be recycled, of which 85% can be recovered through mechanical recycling and 10% through energy recovery and thermal recycling. This fact has prompted product redesign and adaptation of technologies to promote the use of recycled composite materials. Such advances provide the means to comply with environmental and social commitments that are in high demand.
- ***Technologies:*** Current processes for recycling composites are not competitive enough due to the lack of maturity of available technologies, thus resulting in products with poor mechanical properties. Another technical drawback is the adaptation of numerical models, which, bearing in mind the premises of these composite materials, make it possible to design environmentally efficient structures with better performances in comparison with those made from conventional materials.
- ***Industries promoting the recycling of composite materials.*** Cohesion between industry and research organizations should be strengthened so that a roadmap for developing recycling strategies could be designed. This would help improve the competitiveness of the industrial community, as well as quality of life

Concept of the Circular Economy in Recycling of Composite Materials

of society in the context of increased respect for the environment.

Keeping an eye on the future

Despite these difficulties, one can view the future of recycling composite materials with optimism, for the following reasons.

The first is that the cost involved in recycling composites is compensated for by legislation prohibiting landfilling and incineration of composite waste. This is due to the increase in the cost of producing the constituent parts that make up virgin composites.

There is an opportunity to develop and adapt the manufacturing processes of parts made with recycled out of autoclave composite materials, using processes such as 3D printing, pultrusion and thermoforming.

The availability of resources and waste management is greater. It is necessary that waste generators and recyclers cooperate more closely on developing infrastructure to collect the material from manufacturing plants.

In order to respond to this challenge, AIMPLAS will lead the European SPARTA project within the framework of the Clean Sky 2 call for proposals, with the participation of TEKNIKER technology centre. The main goal of the project is to develop an innovative methodology for recycling thermoplastic composite materials, and thus obtain new products with advanced mechanical properties. The project is scheduled to begin in September 2020 and will address strategic challenges for aviation, with regards to ecodesign and environmental sustainability as defined in the Strategic Research and Innovation Agenda (SRIA) prepared by ACARE.

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More information:
www.aimplas.es

References

[1] https://ec.europa.eu/environment/circular-economy/
[2] https://ec.europa.eu/transport/themes/urban/clean-vehicles-directive_en
[4] https://eur-lex.europa.eu/legal-content/EN/