17th International Conference on Advanced Computational Engineering and Experimenting
BARCELONA, 1-5 July 2024
www.acex-conference.com

ABSTRACT:

Development of 3D Foams Fully based on Recycled Short Carbon Fiber from Continuous Fiber-Reinforced Polymers Waste

A. Jiménez-Suárez1, L. Benedettin2, L. Lou2. K. Orikasa2, A.K. Sukumaran2, A. Agarwal2
1 Materials Science and Engineering Area, Universidad Rey Juan Carlos, Móstoles, Madrid, 28933, Spain.
2 Mechanical and Materials Engineering, Florida International University, Miami, Florida, 33174, USA.

The use of continuous fiber-reinforced thermoset polymers has experienced a huge increment during the last decades. They are widely used in transportation technologies such as aircraft or train structures, wind blades, or sports goods. Particularly, their application in aircraft and wind blade industries makes use of a great amount of these materials which, up to date, do not present an easy and direct through way of recycling or reusing. Their particularly good properties and high stability make them particularly difficult to recycle. Most of the wind blades that are reaching their end of in-service life are currently disposed of in the field, being pyrolysis another alternative which is neither an environmentally friendly approach.
The use of mechanical recycling for CFRPs (Continuous Fiber Reinforced Polymers) is a good option in terms of energy consumption and lack of contaminant emissions, nevertheless, the reduction of the fiber length leads to an important decrease in their reinforcement capabilities. The work done focuses on the development of multifunctional materials from these mechanically recycled materials. In this way, the added value of the new materials manufactured is based on their functional properties (electrical conductivity and sensing capabilities) rather than their mechanical properties.
The 3D foams were obtained by a freeze-drying process by the suspension of the milled carbon fiber in water with 1 % polymer binder, resulting in recycled short carbon fiber-based foams that are almost completely based on recycled products. Changing the origin of CFRP scrap (prepreg or end-of-use cured parts) and the solid content in

the initial suspension, the foam structure and electrical properties changed. The electrical network created by the carbon fibers was susceptible to strain thus, resulting in foams that constituted strain sensors fully based on recyclable products. The sensing capabilities of some of the foams were extremely high, detecting variations of less than 5 N in all the cases. These results are particularly interesting as the resulting foams are a high-added value product made from the mechanical recycling of CFRP waste.