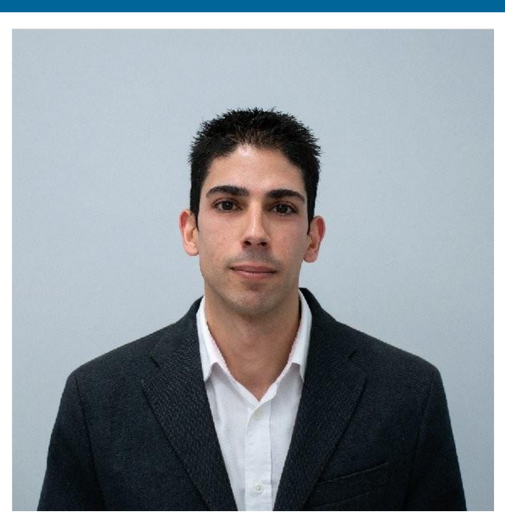

TEXTILE TECHNOLOGIES FOR THE VALORIZATION OF CARBON FIBRE AND OTHER REINFORCEMENT FIBRES FROM RECYCLED COMPOSITES

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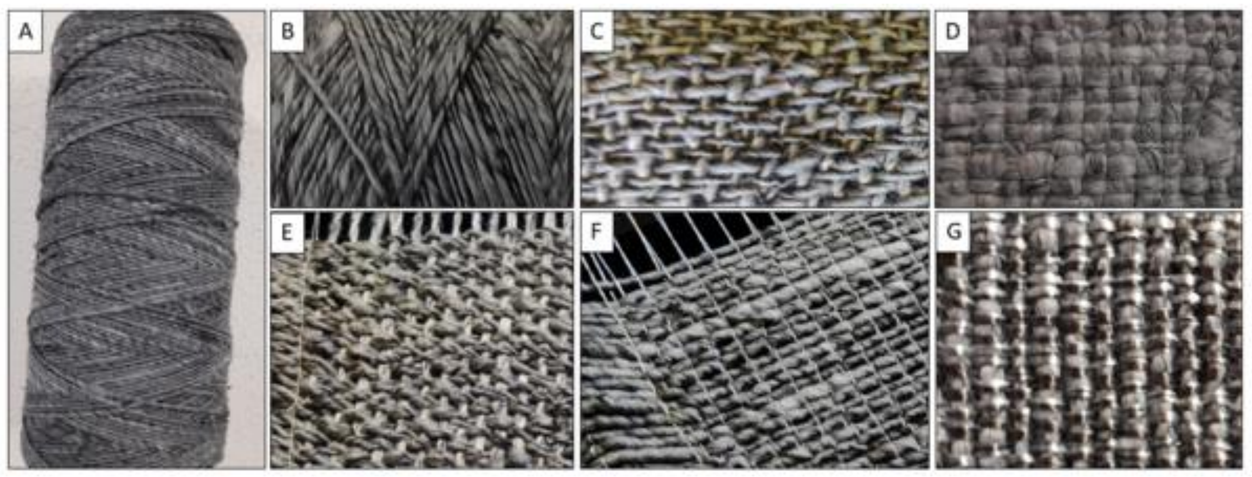
Abstract

This study focuses on adapting textile technologies for processing recycled carbon fibre and other fibers from recycled composites. Challenges include modifying textile processes for manipulate fragile, high conductivity, static electricity, and low flexural resistance fibres. Results include yarns and fabrics from recycled carbon fibre, suitable for new thermoplastic composites. Linear fiber alignment in yarns and fabrics enhances several mechanical properties compared to nonwovens. Textile technologies like blending, carding, and spinning are crucial for processing. Overall, the research aims to valorize recycled fibres by creating textile intermediates for high-performance composites, addressing mechanical property advantages and limitations through innovative processing methods.

Methodology

The innovative textile structures in this study, predominantly based on rCF yarns, have been achieved through the development of an innovative process by AITEX in the stages of carding, manipulation of carding slivers, and spinning. These innovations are protected and described in patent application P202330884.

Innovative textile materials based on rCF yarns



Yarns and fabrics: (A) rCF/PA6 Yarn, (B) rCF/PA6 Yarn Detail, (C) 5-Hard.Satin rCF/PA6 Fabric, (D) Plain rCF/PA6 Fabric, (E) Twill 2.2 rCF/PA6 Fabric, (F) UD (Unidirectional) rCF/PA6 Fabric, (G) Hybrid Plain CF-3K and rCF/PA6 Fabric.

Objective

The main objective of this work has been to determine the mechanical properties of two composites made with recycled fiber: (1) Non-woven 50% rCF-50% PA-6, and (2) Fabric made from 50% rCF-50% PA-6 yarn. These properties were then compared to those of a counterpart made with virgin fiber, (3) woven from 50% CF-50% PA-6 commingled yarn. The thermoplastic composites were produced under the same conditions of pressure, density, and temperature cycles in all cases.

To demonstrate whether the higher degree of fiber alignment in the developed yarn-woven fabrics improves the mechanical properties of the composites compared to random structures such as nonwovens.

Results

rCF Nonwoven (1.200 gsm)

rCF fabric (2x600 gsm) Plain

CF-3K fabric (2x600 gsm) Plain

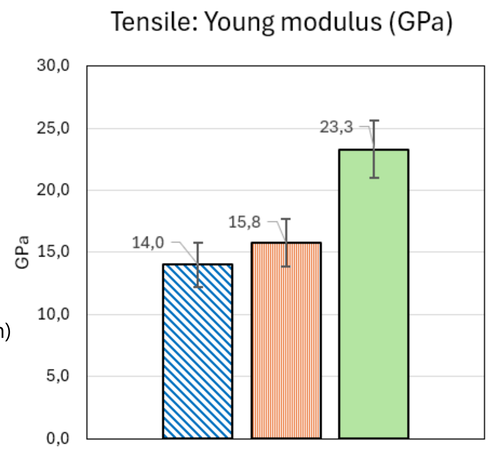
Hot plates – 10 MPa
240ºC

24ºC/min (Heating)
20ºC/min (Cooling)

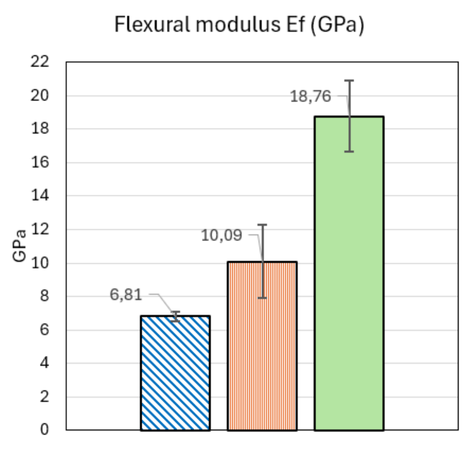
TPC (766 kg/m3 -1,7 mm)

TPC (1.206 kg/m³- 1,2 mm)

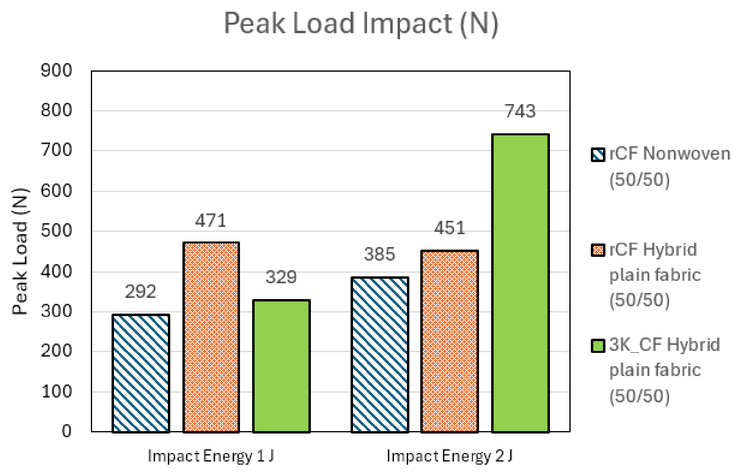
TPC (1.318 kg/m³ - 0,8 mm)



Tensile test ASTM3039



Bending test ISO 14125 (3 Points)



Impact test ASTMD7136M-15

Conclusions

The results demonstrate that using recycled carbon fiber yarns in composite manufacturing significantly enhances compaction, density, and mechanical properties compared to nonwoven solutions. Composites with these yarns exhibit greater stiffness, impact resistance, and promising mechanical performance, comparable to continuous carbon fiber hybrid fabrics.

These findings highlight the potential of recycled carbon fiber yarns in developing high-performance composite materials for non-structural applications, suggesting future research into combining continuous filaments with recycled fibers to optimize mechanical properties and minimize environmental impact.

Acknowledgements

Funded by the European Union under Grant Agreement Project No 101091691. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. The European Union cannot be held responsible for them.

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Funded by the European Union

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