FLAX AND GLASS FIBRE REINFORCED PP COMPOSITES: ADHESION BETWEEN PP AND REINFORCING FIBRES

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INTRODUCTION

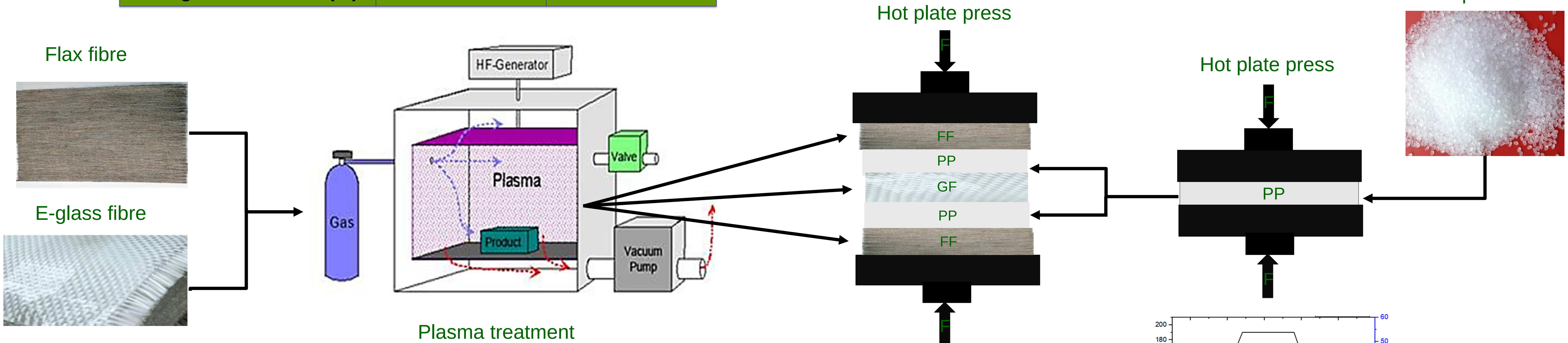
In different industries, numerous works are being carried out to introduce alternative composite materials, using natural fibres as reinforcement and thermoplastics polymers as matrix, so that at their end of life they can be recycled. However, due to their poor mechanical characteristics, the need arises to create a hybrid composite material that has the recyclability characteristics and also the necessary strength to meet the requirements of the industry.

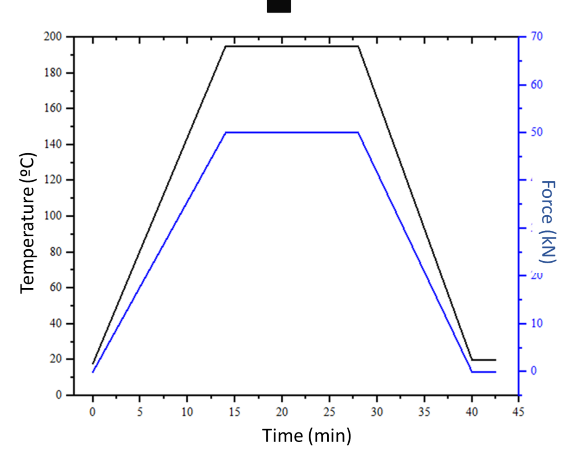
One of the greatest challenges for this type of material is to improve the poor surface adhesion between reinforcement and matrix due to the low wettability of natural fibres. The present research aims to modify the surface of the natural fibre fabric by means of physical treatments, also combining it with synthetic fibres and thus aiming to create a composite material with high mechanical properties, competitive with conventional composite materials.

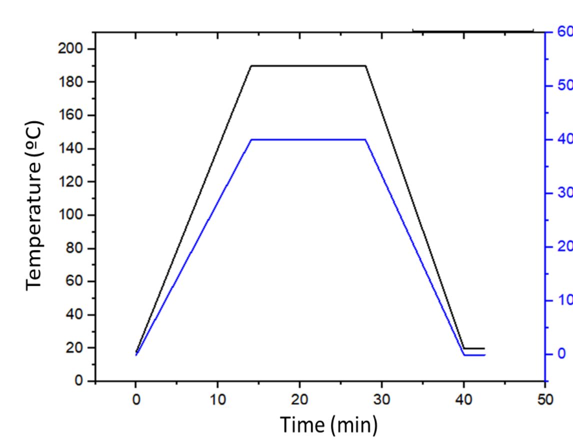
EXPERIMENTAL PROCEDURE

	E glass fibre	E flax fibre
Degradation T (ºC)	≈846	≈250
Young Modulus (GPa)	76	27.6
Tensile strength (GPa)	1.4-2.5	0.8-1.5
Elongation at break (%)	1.8-3.2	1.2-3.2

By using a low-pressure cold plasma surface treatment on the flax fibre, it was possible to decrease the contact angle, thus increasing the wettability of the thermoplastic on the reinforcement.



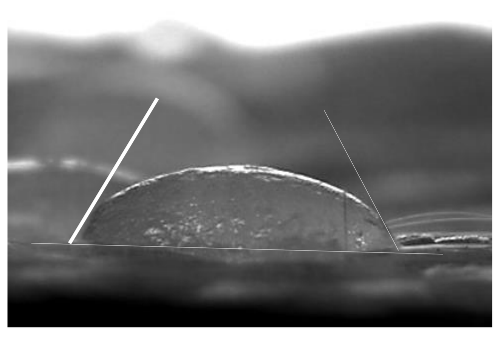


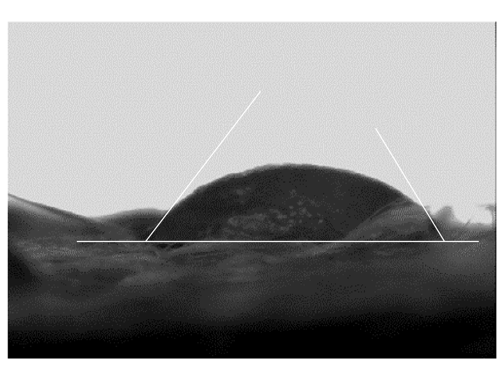


The thermogravimetric analysis of the flax fibre provided the temperature at which the fibre start to degrade (250ºC). The melting temperature of the polypropylene was obtained by DSC (165 ºC). The manufacture of the composites was carried out by means of a hot plate press, being necessary to optimise the pressure, temperature and time parameters.

RESULTS

Plasma treatment effect

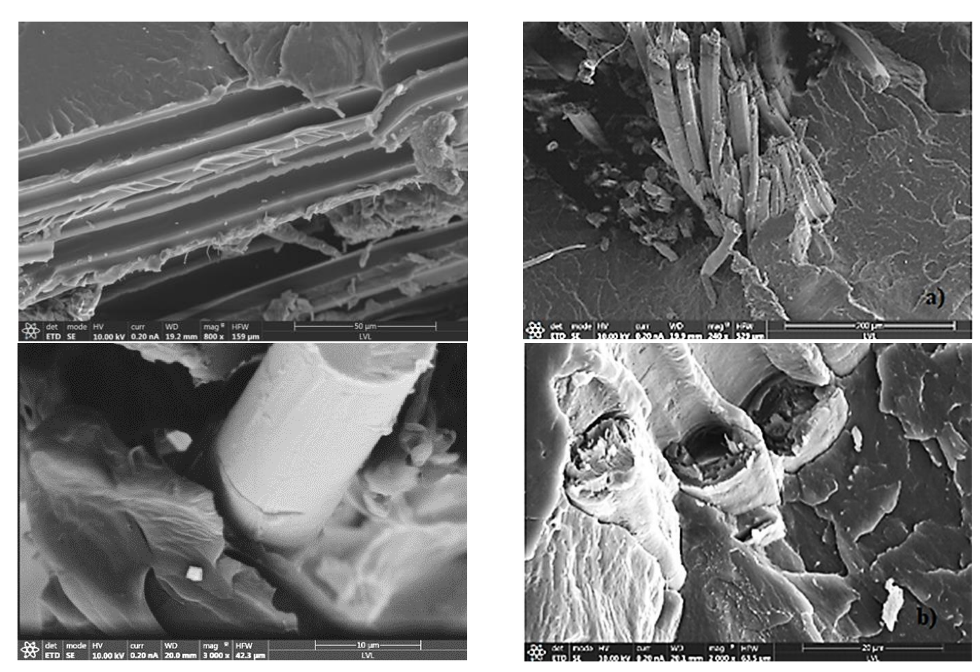

Glass Fibre/Liquid PP


Flax Fibre/Liquid PP

Plasma treatment improves the wettability of the PP on the fibres when melted at 180°C.

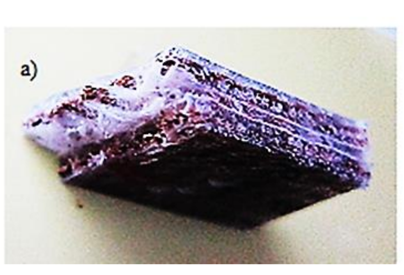
Better wetting of the fibres improves the load transfer from the matrix to the fibres.

Fracture surfaces: Good adhesion

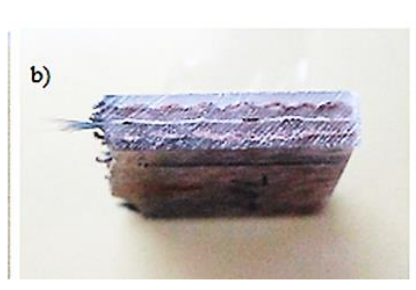


Glass Fibre/PP Flax Fibre/PP

Tensile test

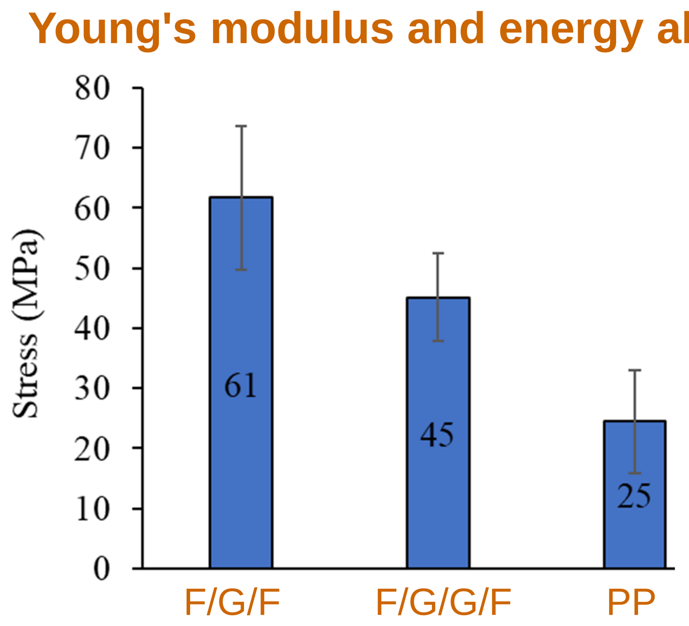


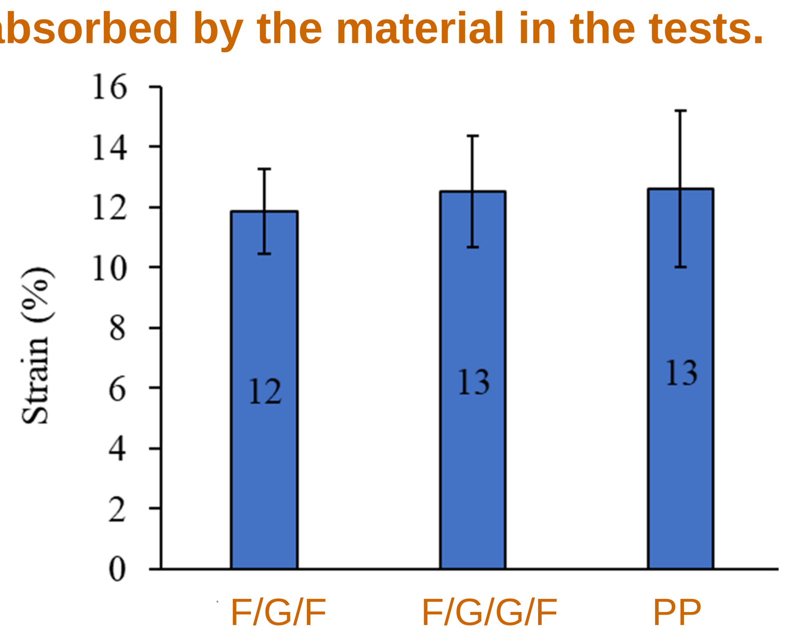
F/G/G/F

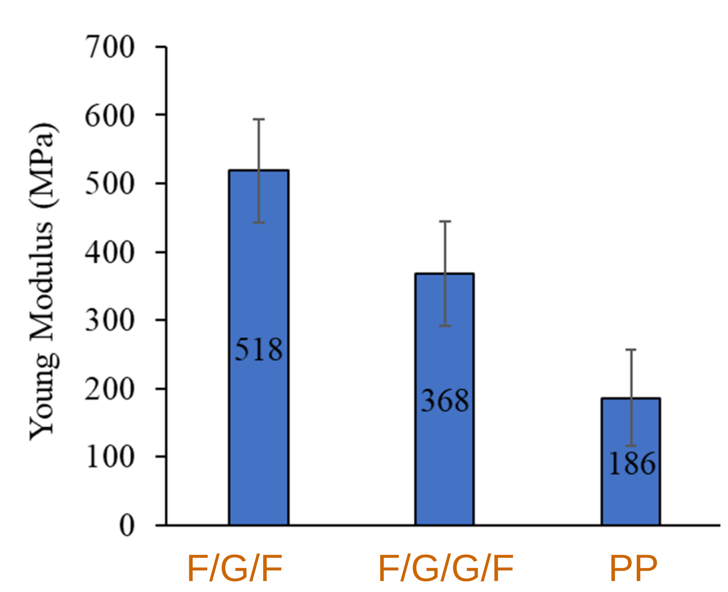


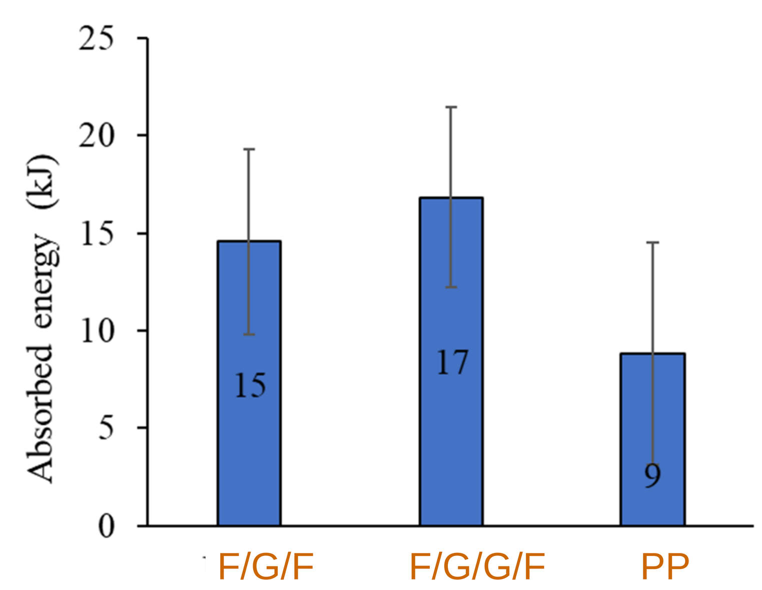
F/G/F

When increasing from 1 to 2 layers of glass fibre, the thickness increases and the breaking strain decreases. There is an increase in Young's modulus and energy absorbed by the material in the tests.









CONCLUSIONS

The materials obtained are mechanically characterised by means of tensile test, obtaining the maximum tensile stress, elasticity modulus and energy required to cause fracture. The results show that the inclusion of a glass layer between the flax layers increases the strength of the material by 40 %. A second layer of fibre reduces the stress due to the increase in cross-section and only provides a 6 % increase in strain and a 15 % increase in the energy required to cause the material to break. By SEM, it is possible to observe the good interfacial adhesion between the flax fibres and glass fibres and the PP matrix.