PROCESSING AND PROPERTIES OF COMPOSITES OBTAINED FROM NATURAL FIBRES AND THERMOSETTING MATRICES

A. C. Duro[1], B. F. Castro[2], J. F. Silva[2], J. P. Nunes[3]
[1] Department of Polymer Engineering, Minho University, 4800-058 Guimaraes, Portugal
[2] Dep. of Mechanical Engineering ISEP, 4200-072 Porto, Portugal
[3] Institute of Polymers and Composites/I3N, Minho University, 4800-058 Guimaraes, Portugal
* Corresponding author (jfs@isep.ipp.pt)

Abstract

In the last few decades, polymers have replaced, advantageously, many of the conventional materials, in various applications. These materials have low density, are easy to process and, many polymers are low-cost. Traditional composite structures still use thermosetting matrices, (usually a polyester system), but, more recently, thermoplastic matrices are being used in composite structures, because they allow shortening process cycle time, they have better impact behaviour and are more ecological. However, the use of thermoplastic matrices makes difficult and complex the impregnation of reinforcements and the consolidation tasks due to their very high viscosity [1].

Because of some very interesting properties, natural fibres are recently being studied as reinforcement material in composite components. They are low-cost fibres, combining very low density with high specific properties, are biodegradable and nonabrasive, unlike other reinforcing fibres and are readily available [2].

In this work, different natural fibres were studied and characterized, using optical and SEM microscopy. Those fibres were used to reinforce polyester and epoxy matrices and produce composite plates by hand lay-up. A vacuum bag was then used to allow improving the fibre impregnation, establishing a controlled pressure atmosphere.

All different obtained composite plates were submitted to mechanical testing, in order to determine relevant mechanical proprieties. The produced composites were, namely, submitted to flexure and tensile tests, in accordance to ISO 14125 and ISO 527, standards, respectively.

It was also determined, for each type of composite, the G_{IIc} property (critical energy release rate in mode II), in order to assess their impact behaviour.

Already obtained results allow us to conclude that a good impregnation of the used natural fibres was achieved and that the composite mechanical properties are compatible with more conventional engineering materials.

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References

1. Nunes, J. P., Silva, J. F., van Hattum, F.W. J., Bernardo, C. A., Marques, A. T., Brito, A. M. and Pouzada, A. S., “Production of thermoplastic towpregs and towpreg-based composites” in Polymer Composites – From Nano- to Macro-Scale, Eds K. Friedrich, S. Fakirov and Z. Zhang, Eds Kluwer Academic Publishers, 2005.

2. D. Nabi Saheb and J. P. Jog “Natural fiber polymer composites: A review” Advances in Polymer Technology, Vol. 18, No. 4, pp. 351–363 1999.