PRODUCTION OF THERMOPLASTIC MATRIX PRE-IMPREGNATED MATERIALS TO MANUFACTURE COMPOSITE PULTRUDED PROFILES

V. Tinoco[1*], P. J. Novo[2], J. P. Nunes[3], J F. Silva[4] and A. T. Marques[5]

[1] Department of Polymer Engineering, Minho University, 4800-058 Guimaraes, Portugal
[2] School of Tech. and Management, Polytechnic Institute of Leiria, 2411-901 Leiria, Portugal
[3] Institute of Polymers and Composites/I3N, Minho University, 4800-058 Guimaraes, Portugal
[4] Dep. of mechanical Engineering ISEP, 4200-072 Porto, Portugal
[5] DEMEGI / FEUP, 4200-465 Porto, Portugal

* Corresponding author (pnovo@estg.ipleiria.pt)

Abstract

Thermoplastic are replacing thermosetting matrices in long and continuous fiber reinforced composites due to their better ecological and mechanical performance. Their use in long/continuous fiber reinforced composites involves, however, great technological and scientific challenges since thermoplastics present much higher viscosity than thermosettings, which makes much difficult and complex the impregnation of reinforcements and consolidation tasks.
Sometimes, thermoplastic compatibilizers are added to matrices to improve their adhesion and facilitate impregnation to reinforcements [1]. Therefore, this work analysis the possibility of using maleic anhydride as compatibilizer of carbon fiber reinforced polypropylene (CF/PP) pre-impregnated towpregs.
The aim of the work was optimizing the continuous production of new continuous carbon fibers reinforced polypropylene matrix pre-impregnated materials (towpregs). This raw-material, produced by dry deposition of polypropylene (PP) powder in an equipment built by the Institute for Polymers and Composites (IPC) [2], was used to manufacture composite pultruded profiles in a recently developed prototype equipment assembled in the Engineering School of the Polytechnic Institute of Porto (ISEP) [3].
The optimization of both processes was made by studying the influence of the most relevant processing parameters in the final properties of the produced towpregs and composites made. The method of Taguchi / DOE (Design of Experiments) was used to achieve this aim and allow making much more rational choices of the processing windows to be used.
Towpregs were characterized by scanning electron microscopy (SEM), visual analysis and their polymer mass contents were also determined. The final pultruded composite profiles were also submitted to tensile, interlaminar, flexural, calcination and optical microscopy tests.

Acknowledgements

The authors wish to thank the Engineering School ofthe University of Minho, PIEP – Pole for Innovation in Polymer Engineering and the School of Engineering of the Polytechnic of Porto, for the support given to this work. They also acknowledge the Portuguese Foundation for Science and Technology for the financial support of IPC through project PEst-C/CTM/LA0025/2013 (Strategic Project - LA 25 - 2013-2014).

References

[1] J. F. Silva, J. P. Nunes, F. W. Van-Hattum, C. A Bernardo and A. T. Marques “Improving Low-Cost Continuous Fibre Thermoplastic Composites by Tailoring Fibre-Matrix Adhesion”. International Workshop on Thermoplastic Matrix Composites, 11-12 September, Gallipoli, Italy, 2003.

[2] R. F. Silva, J. F. Silva, J. P. Nunes, C. A. Bernardo and A. T. Marques. “New Powder Coating Equipment to Produce Continuous Fibre Thermoplastic Matrix Towpregs”. Materials Science Forum, Vol. 587-588, pp. 246-250, 2008.

[3] Nunes, J. P., Silva, J. F., Novo, P. J. “Processing Thermoplastic Matrix Towpregs by Pultrusion” Advanced in Polymer Tech., Wiley, ISSN: 1098-2329, Doi:10.1002/adv.21279, 2012.