11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Evaluation of additives content (natural filler, plasticizer and nucleating and compatibilizing agent) on the production of biodegradable PHB-based composite

J. S. Macedo[(1)*], R. M. S. M. Thiré[(1)], M. F. Costa[(1)]

(1) PEMM/COPPE, Universidade Federal do Rio de Janeiro, e-mail: jeremias@metalmat.ufrj.br
* Corresponding author.

Abstract – Biodegradable composites based on PHB and coir dust were processed by extrusion followed by compression molding. The effects of filler and others additives such as plasticizer, nucleating agent and compatibilizing agent on the mechanical properties were evaluated by tensile and creep tests, while physical properties were evaluated by SEM and XRD.

Advantages that plastics can offer in different fields of application together with the need of developing a sustainable society led to a great interest of scientists on biodegradable polymers [1-2]. However, the commercial use of biodegradable polymers has still several drawbacks due to its high cost and incompatible mechanical properties for engineering applications. In this study, polyhydroxybutyrate (PHB), a biodegradable polymer synthesized by bacteria, was used as matrix for the development of a biodegradable composite. The waste generated by the coconut fibers processing (coir dust) was employed as filler aiming at improve the mechanical properties and reduce the cost of the product. Other additives such as plasticizer (hexylene glycol) and commercial nucleating and compatibilizing agents were also employed. In order to study the effect of the additives content on film properties, different compositions were prepared. The content of the components varied from 88.1 to 73.3 wt% for PHB, 1 to 9 wt% for coir dust, 10-20 wt% for plasticizer, 0.4 to 1 wt% for nucleating agent and 0.5 to 1.5 wt% for compatibilizing agent. In turn, the samples were identified as C1, C2 and C3 corresponding respectively to low, medium and high content of additives. The mixtures were processed in a single-screw extruder 25mm (temperature range 90-145ºC at 30 rpm) followed by compression molding (165ºC under 3 ton for 3 min). Mechanical tests were carried out in a mechanical tensile universal tester Instron model 5567 under a cross-head speed of 2mm/min at room temperature (about 23^{o}C). Preliminary mechanical tests showed that an increase of content of all additives led to a reduction in tensile strength and a decrease in resistance to creep (under a load of 3 Mpa for 12 min) of the composites, as showed in **Table 1.** These results seem to be related to a possible cooperative effect exerted by all the additives when they are presented in higher content, which facilitated processing and reduced the stiffness of the polymer. Further analysis by Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD), will be conducted to help elucidating the individual effect of components on the other properties of the composites.

Table 1: Mechanical Properties: Tensile and Creep Tests

Composite	Tensile Strength (MPa)	Creep Strain (%) under a load of 3 MPa
C1 (low content)	27,0	1,0
C2 (medium content)	22,8	0,9
C3 (high content)	10,4	1,3

Acknowledgements – The authors thank CNPq and FAPERJ for financial support and PHB Industrial S/A and Clariant for the supply of PHB and nucleating and compatibilizing additive, respectively.

References

[1] R.C. Baltieri, L.H.I. Mei and J. Bartoli, Macromol. Symp, 197 (2003) 33.

[2] D.Z.Bucci, L.B.B.Tavares and I.Sell, Polymer Testing, 26 (2007) 908.