"Characterization of Biodegradable Blends of PHBV/Tannin and PHBV/Lignin of sugarcane bagasse"

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Statement of Purpose: Some of more significant developments in materials technology have come in the area of multi components polymers systems. These developments have been led by the success of high strength, lights weight fiber reinforced polymers, although considerable attention remains focused on polymers blends, which offer the potential of much simpler fabrication technology[1]. Environmentally degradable polymers are an attractive route to environmental waste management and can replace conventional polymers when recovery for recycling or incineration is difficult and expensive[2]. Research has focused on the addition of two natural polymers for obtaining of a biodegradable blend, lignin from sugar cane bagasse, tannin and poly(3-hydroxybutyrate-co-valerate) or PHBV, a polyhydroxyalkanoate's (PHAs) family member obtained from bacteria, are good options for the future[3], this materials are naturals and biodegradable[4].

Methods: Materials: The lignin from sugarcane bagasse/PHBV (w/w) blend and tannin/PHBV (w/w) blend, samples were prepared using lignin from sugarcane bagasse, supplied by FAENQUIL-Lorena – SP/Brazil, and PHBV (molar mass 400.000–250.000 Da and 18% de HV) kindly supplied by Centro de Tecnologia da Copersucar (Piracicaba-SP)/ Usina da Pedra (Serrana-SP) and Tannin by Rhodia Campinas -SP–Brasil.

1-The blends films, as well as of the pure materials were obtained in a Teflon form of approximately of 50 cm of external diameter, 41 cm of internal diameter, 11 cm of height and 4 cm of depth. The samples were prepared in a ratio of 50%/50% (w/w) of the pulp lignin of sugarcane bagasse and PHBV (18% of HV), dissolved in chloroform in a 4%, related to blend (w/w). The material was under agitation for 24 hours, it was placed in the Teflon form by one week and placed in a system for the evaporation at room temperature.

2. The blends in the proportion 50%/50% (w/w) of lignin sugarcane bagasse and PHBV (18% of HV), were obtained through mechanical mixture using single screw extruder in an instruments Haake Fisions Rheocord 90. The conditions of the blends processing in the instruments Haake were rotation of 90 rpm, temperature of 175 ^{o}C and the time of 8 minutes. The blends were processed by extrusion as following: single screw of 19.1 mm, ratio L/D = 25.0 mm and the temperature of 160^{o}C.

Analytical procedures: The pure polymers and blends were analyzed by: (a) Fourier Transform Infrared Spectroscopy (FTIR), using a BOMEM Michelson MB Series equipment, with a resolution of 4 cm^{-1} and KBr windows, (b) Differential Scanning Calorimetry in a DSC 2910 from TA Instruments, (c) Scanning Electron Microscopy (SEM) in a Jeol T-300 operating at 15 keV, (d) Thermogravimetry in a modulate TGA 2050 from TA instruments and (e) Tensile properties were measured according ASTM (D-638) using an EMIC DL 2000 testing machine (load cell 5000 N with crosshead speed 5.0 mm min^{-1}).

Results / Discussion: It was obtained blend of lignin (sugarcane bagasse and tannin) with PHBV and were immiscible. The morphological analysis of lignin sugarcane bagasse/PHBV blends based on MEV showed a progressive phase separation as the amount of lignin increases in the blend, leading to a material with absence of continuous phase. It was observed the presence of dispersed grains over the matrix surface, probably from lignin component. This was an evidence of the absence of miscibility between the blend components due to the poor interfacial adhesion between them, this increased with increases of the lignin proportion in the sample. In the thermal analyses of the blends we can notice that the material added to the PHBV did not influence these properties, so that the characteristic points of the curves of DSC, are the same ones found for pure PHBV. This fact is interesting for the cost of the material. PHBV is an expensive material, but it is very useful as substrate for controlled delivery of drugs. If its physical and chemical properties stay the same we can use blends for this purpose, as well as for controlled delivery of agrotoxic in agriculture reducing in the environments pollution.

Conclusions: It was obtained blends with the lignin macromolecule of lignin of sugarcane bagasse with the polymer PHBV (50%/50%) and tannin with PHBV in films and in a Haake instruments. The thermal analyses equipment revealed that the produced blends possessed very similar thermal properties as PHBV, indicating that there is not interaction between the polymer (PHBV) and the macromolecule (Lignin) used. This was confirmed in the analyses of MEV, where the presence of emptiness was observed among the interfaces of the polymeric ones, concluding that the blends is immiscible.

References:

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