Characterization of films of PHBV/Cellulose Nanocrystals nanocomposites after biodegradation in liquid medium

A. P. da Silva[1,*,#], T. L. A. Montanheiro[1], L. S. Montagna[1], A. P. Lemes [1]

[1]Laboratory of Polymer and Biopolymer Technology, Institute of Science and Technology, Federal University of São Paulo, São José dos Campos, São Paulo, Brazil

[#]Corresponding author: a.silva16@unifesp.br

Biodegradable polymers have great importance due to environmental problems caused by the long life time of synthetic polymers. Among biodegradable polymers, the poly(3-hydroxybutyrate-co-3-hydroxyvalerate), PHBV, has great interest because its properties are similar to polyethylene and polypropylene properties. But its application is still limited by low mechanical resistance [1,2]. Some works had studied the development of PHBV nanocomposites with the objective to improve mechanical properties of PHBV materials. However, the study of nanoparticles in the biodegradability of PHBV it is also important for its application. Thus, in this work the biodegradation of PHBV/CNC nanocomposites containing 1, 2 and 3% (w/w) of CNC by bacteria in liquid medium was evaluated. Films of PHBV and PHBV/CNC obtained by solvent casting were immersed in a mineral solution containing a bacteria suspension and maintained at 30°C for 12 days with stirring of 120 rpm. The samples were washed and dried, then photographed and characterized by mass loss and scanning electron microscopy (SEM). The nanocomposites of PHBV/CNC with 1, 2 and 3% (w/w) of CNC remain biodegradables. The films did not suffer physical degradation when they was exposed only to the mineral medium during the studied period, thus proving that the degradation of the nanocomposite was carried out by the action of the consortium of bacteria isolated from soil. The introduction of CNC in the polymer matrix did not change the biodegradation process in the studied nanofiller concentration, since the values of mass loss did not have significant difference between pure PHBV and PHBV/CNC nanocomposites. SEM micrographs also confirmed the results of visual analysis and mass loss. The samples showed a uniform surface deterioration and it was not observed difference in the surface between PHBV and PHBV/CNC nanocomposite. The samples immersed in mineral solution showed no surface change during the studied period.

[1] D. N. Bikiaris. Nanocomposites of aliphatic polyesters: An overview of the effect of different nanofillers on enzymatic hydrolysis and biodegradation of polyesters. Polymer Degradation And Stability, Thessaloniki, v. 98, n. 9, (2013) 1908-1928.

[2] M. Martinez-Sanz et al. Characterization of polyhydroxyalkanoates synthesized from microbial mixed cultures and of their nanobiocomposites with bacterial cellulose nanowhiskers. New Biotechnology, Valencia, v. 31, n. 4, (2014) 364-376.