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BIODEGRADATION TEST OF BINARY BLENDS OF PHBHV WITH PHEMA BY FUNGAL SPECIES APPLYING A ASTM MODIFIED METHOD

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Abstract. Polymeric blends of PHBHV and PHEMA were tested with a ASTM G21-90 modified method. O_2 and CO_2 were the parameters of utility for the determination of the biodegradation. Surface erosion was observed of scanning electronic microscopy of the samples after experiments of biodegradation. *Penicillium funiculosum* was the fungal specie with major biological activity.

Introduction. The poly(hydroxyalcanoates) (PHAs) are biodegradable polymers. The blend of polymers is a beneficial practice from reduces costs and improves a particular property. Poly(hydroxybutyrate-co-hydroxyvalerate) (PHBHV) has been blended with synthetics polymers such poly(methylmethacrylate) and (PMMA), poly(propylene) (PP). The ASTM G21-90 method can supply information about of degradation mechanism. In the other hand, use of CO_2 evolution and loss mass has been use from determinate the biological activity on the polymers [1]. Surface erosion can be observed when biological activity is present. The chemical degradation in polymers occurs in the bulk of material [2].
The aim of this work is tested the biodegradation of PHBHV and PHEMA and three blends of them using a ASTM modified method.

Materials. PHBHV with 21% HV units was obtained by fed-batch fermentation with *Ralstonia eutropha* ATCC 17699 [3]. Hydroxyethylmethacrylate (HEMA) was purified by distillation over calcium hydride at reduced pressure. The polymer was prepared by free-radical polymerization at 70°C for 18 h under nitrogen atmosphere. Both polymers were characterized by different techniques as previously reported[4]. The blends were prepared by slowly casting films from chloroform. The composition of the samples submitted to biodegradation studies was explored in a range of 20-50 % PHEMA on PHBHV. The ASTM G21-90 technique was modified to test biodegradation. The modified test consisted in the measure of CO_2 and O_2 as a function of the time. Films of 10*10 mm were tested for degradation in presence of a conidial mix of the five fungal species on purified agar at 28° C. Experiments were performed in sealed 125 ml Erlenmeyer flasks and CO_2 evolution was measured by a titrimetric method [5]. Drop of pressure in the flask was correlated with oxygen uptake. O_2 concentration was indirectly measured with a potentiometer sensor (Centre point, Ireland). Physical changes on the surface of the films were observed with a Zeiss scanning electronic microscope model DSM 940A using an acceleration voltage of 10 kV.

Results. Our results showed that the velocity of biodegradation increase as the PHBHV percent in the blend do it. The profiles of CO_2 production (see Fig. 1) suggest that fungal activity starts after three days on the samples with 20 % and 30 % of PHEMA content.

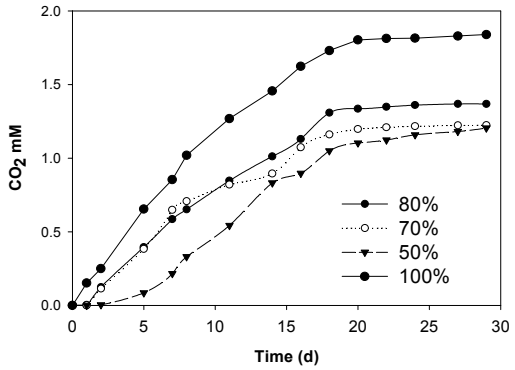

FIGURE 1. TOTAL CO_2 PRODUCED BY THE SAMPLES AS PHBHV CONTENT.

At day ten, sample with 50% of PHBHV was impossible to recover due to the high level of degradation. When only PHEMA was present, no fungal degradation was observed after 30 days of incubation. It can be considerate a non-biodegradable polymer [6]. The surface topography of the film with 70% of PHBHV, after 7 days degradation (30% mass loss), looks very irregular, and shows holes with a diameter about fifteen microns.

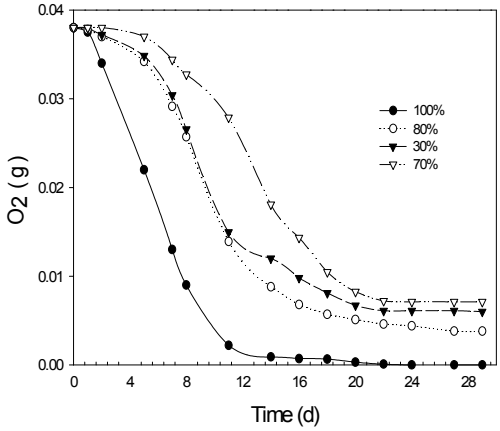

FIGURE 2. UPTAKE O2 PROFILES OF SAMPLES AS PHBHV CONTENT.

The results of O_2 uptake (see figure 2) showed a positive effect of the PHBHV percent on the degradation rate of the samples. We could observed that the biological activity started first in the samples with major content of PHBHV. While that in the sample with PHEMA as only one component did not showed any activity. The results of SEM showed the presence of holes in the surface of the samples after biodegradation test. The surface of the samples was similar at the surface of PHBHV pure. The topography was irregular and porous. We could observed in the samples tested a surface erosion (see Figure 3). Therefore, the micrographs showed that the morphology of the surface play an important role in the biological activity.

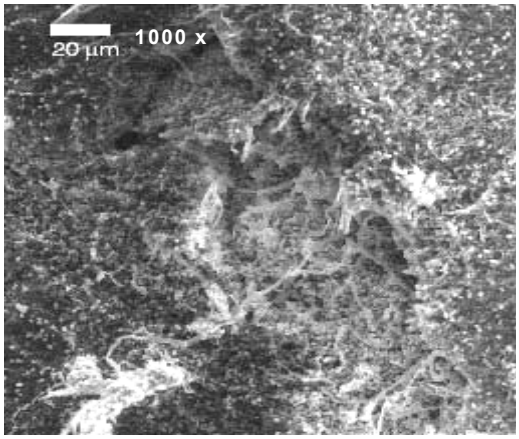

FIGURE 3. SURFACE OF THE SAMPLE WITH 50% OF BOTH COMPONENTS.

Penicillium funiculosum was the fungi specie of the test with high biological activity.

Finally we can conclude that the blends of both polymers are biodegrable. Actually we are working with other blends using others synthetic polymers.

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