11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Biodegradation studies on blends of PDLLA and PVP

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Abstract – Trying to minimize environmental problems of wide use of conventional polymers, biodegradable polymers have emerged as an alternative. Among these, poly(D,L-lactide), PDLLA, and poly(vinylpyrrolidone), PVP, have received much attention due to a wide range of applications. PDLLA, however, is hydrophobic, which hinders its application. Mixing PDLLA and PVP (a hydrophilic polymer) we hope to obtain blends showing the biodegradability of PDLLA and the hydrophilicity of the PVP. We report here the results on the evaluation of the biodegradation, using the Sturm test, for blends PDLLA/PVP. The results showed that the degradation of the blend is faster than the pure PDLLA.

The substantial increase in the use of polymers of petrochemical origin, in recent decades, has lead to the accumulation of large amounts of waste. In general, these materials are discarded very quickly and, due to their slow degradation rate, represent a serious environmental problem. To overcome this problem, one of the solutions is the use of biodegradable polymers, which have attracted an increasing interest due to the diversity of its applications in the areas of medicine and biotechnology.

Among biodegradable polymers, have been extensively studied the poly (D,L-lactide), PDLLA, which has great potential for application in the medical, pharmaceutical, and packaging areas. However, being highly hydrophobic, the applications of PDLLA are limited.

Poly(vinylpyrrolidone), PVP, is another polymer commonly used in applications in medical and pharmaceutical areas. PVP is an amphiphilic polymer soluble in a large variety of solvents. The preparation of blends based on PVP and PDLLA is a way to produce a material combining the hydrophilicity of PVP with the biodegradation of PDLLA.

Thus, in this paper we report the studies on biodegradation of blends PDLLA/PVP using the Sturm Test. The ASTM, to evaluate the biodegradation, through the Committee for Environmentally Degradable Plastics has proposed several methods for analyzing and monitoring the biodegradation of polymers, including the Sturm test. This test is considered the most reliable for evaluate the biodegradability of a polymer in an active microbial environment.[1]

Pure PDLLA and blend PDLLA/PVP (composition 50/50) were subjected to biodegradation by the method of Sturm.

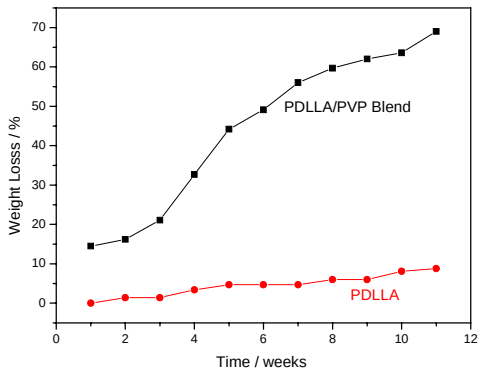

Figure 1: Weight loss of PDLLA/PVP blend and PDLLA

The system of biodegradation was assembled according to ASTM D 6003-96[2], consisting of: air compressor, a solution of barium hydroxide, and bioreactors (300 g of composted soil, i.e., humus with 60% moisture by weight). In pre-determined periods of time, samples were withdrawn from bioreactors, cleaned, and weighed. Figure 1 shows the mass loss of samples during 11 weeks.

The blend PDLLA/PVP showed 70% of decrease in its mass after 77 days of biodegradation. In the other hand, pure PDLLA, in the same biodegradation conditions, showed a low loss of mass and a little change in its visual appearance. This behavior can be explained by the immiscibility of PVP in the PDLLA matrix, which facilitates the diffusion of water through the matrix, resulting in an increased rate of degradation.

References

[1] Rosa, D.S. *Polímeros: Ciência e Tecnologia*, 12, **2002**, 311.
[2] ASTM D6003-96. Standard test method for determining weight loss from plastic materials exposed to simulated municipal solid waste (MSW) aerobic compost environment. Philadelphia, **1996**, 1-8.