

Effect of nutrient on biodegradation process of poly(β -hydroxybutyrate) clay composite

Aline G. Balieiro¹ (IC), Josiane L. Souza (PQ)¹, Roselena Faez^{1*} (PQ)

¹Laboratório de Materiais Poliméricos e Biossorbentes, DCNME, Universidade Federal de São Carlos, Araras, SP, Brasil
alinegbalieiro@gmail.com

Keywords: biodegradation, slow release, fertilizer, nutrient, agriculture

Abstract

Evaluation of the effect caused by the addition of nutrient over the biodegradation process of PHB-clay polymeric blend through Bartha's respirometric assay.

Introdução

The interest for polymeric materials whose degradation process happens through microbiological activity consists an expanding field as the necessity of reducing environmental damage caused by human activity is unquestionable. One alternative to this field is the use of biopolymers for controlled release of fertilizers in agricultural applications. As a contribution, our group has developed biopolymers made out of poly-B-hydroxybutyrate (PHB) combined to starch, clay and glycerin which are able to encapsulate and slowly release fertilizers in the soil. The major advantage of these materials is their capacity of degrade through microbiological activity, resulting in less or even none waste in the soil. In this work, we evaluate the biodegradation process of the polymeric material combined to two different fertilizers: NPK and KNO_3 through Bartha's assay. The test consists basically in measuring the released carbon dioxide arising from the microbiological activity. Our main goal is to verify the effect caused by different nutrients over the biodegradation of the material.

Resultados e Discussão

Figure 1 shows that the PHB-starch blend containing NPK as nutrient was able to degrade in higher proportion compared to the same material containing KNO_3 as nutrient, as evidenced by the greater mass of released carbon dioxide. Qualitative data indicated a loss of mass of 74% for the PHB-NPK blend, and 52% for the PHB- KNO_3 material after the period of incubation, which can aver that both materials were in fact consumed by microbiological activity. FTIR was used to evaluate the structure of the polymeric materials before and after the biodegradation process. It is evidenced that not only the nutrient was consumed in both cases, but also part of the PHB structure was degraded as noticed by the suppression of the C=O vibration at 1654cm^{-1} . In the PHB- KNO_3 spectra, it is possible to notice the

suppression of KNO_3 bands (N-O symmetric stretch at 1381cm^{-1} and N-O aliphatic at 823cm^{-1}).

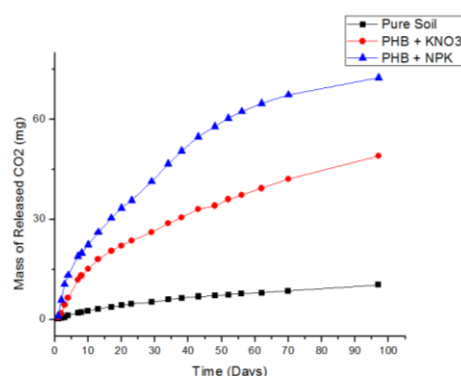


Figure 1. Mass of Released Carbon Dioxide versus time during biodegradation process.

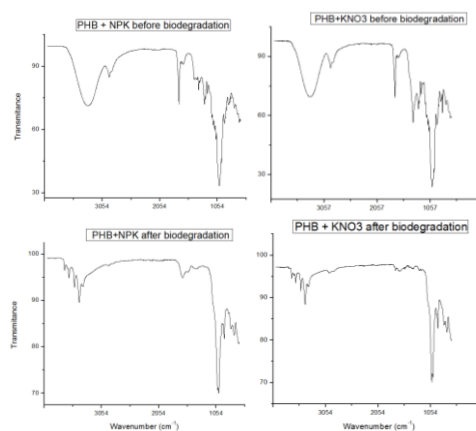


Figure 2. FTIR spectra of the polymeric material before and after biodegradation.

Conclusões

The obtained results prove that both tested nutrients are able to enhance the biodegradation rate of the PHB-starch blend. NPK has turned even more effective in guaranteeing the biodegradation process of the polymeric material.

Agradecimentos

The authors gratefully acknowledge the financial support received from FAPESP and CNPq.

¹ Cerqueira et al. *Bioresource Technology*, 2011, 23, 11003 – 11010.