(23)

Testing the Biodegradability and Biodegradation Rate of Bio-based Film Products in Composting Environment

Senadheera S.K.M.S.[1], Gamage N.S.[2], Jayaweera C.D.[1]*

[1]Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Environmental Management and Assessment Division, Central Environmental Authority, Battaramulla, Sri Lanka
**dangolle@sjp.ac.lk*

Abstract

Bio-based film products have a considerable interest as a replacement for petroleum synthetic polymers of plastics. They are manufactured with a blend of corn starch such as Poly Lactic Acid (PLA) and Poly Butylene Adipate-co-Terephthalate (PBAT) based raw materials that have been specifically engineered to facilitate the process of biodegradation and compost ability. Hence, biodegradable polymers have been regarded as a promising solution to tackle the pollution caused by the wide use of conventional polymers. As the main responsible institute for integrating environmental considerations into the country's development process, the Central Environment Authority of Sri Lanka has taken an action to ban food wrappers (lunch sheets) made from conventional polymers in Sri Lanka. Thus, this study was to determine the biodegradability of bioplastic materials lunch sheets, available on the Sri Lankan market that are labeled as 100% biodegradable but not certified as compostable. The other specific objectives are to identify the biodegradability rate of each brand of lunch sheets, categorize those lunch sheets according to their biodegradability and finally get an idea to determine the optimum conditions for the biodegradation of a bio-based lunch sheet. In this study, the test was carried out in a controlled composting environment located in Gampaha–Dompe Green Park. Three different brands of biodegradable bio-based film products were tested together with cellulose paper as the positive control and nonbiodegradable lunch sheet (LDPE) as the negative control. The project length was 15 weeks. Samples were placed into frames which are made of wooden slats as width=280 mm, length=340 mm and height=50 mm and a 1x1 mm polyethylene mesh was fixed onto the frames. The methodology adopted was based on the study conducted in the Czech Republic in 2016. The emphasis was put on discovering whether bio-based film products are biodegradable or not. The biodegradability of each bio-based film product was tested using Visual inspection; the decomposed samples were inspected visually comparing with initial samples, Weight loss measurement; the initial weight and the weight after decomposition were measured using an analytical balance, FTIR and TGA analysis. Furthermore, the quality of the compost was analyzed using quality parameters such as pH, electrical conductivity, moisture, organic carbon%, nitrogen%, phosphorous%, potassium%, C/N ratio and S. The visual inspection of Sample C revealed large cracks and porous structure than Sample A and Sample B. Positive control was completely digested and the negative control stayed as it is. According to the weight loss measurement analysis, the positive control totally degraded and degradation order was Sample C>Sample A>Sample B. The TGA only suggested a partial degradation of samples. FTIR analysis indicated that the positive control was totally biodegradable, Sample B and sample C partially biodegradable and Sample A and negative control were not biodegradable. Based on the results it can be concluded that bio-based film products have not decomposed completely but their color, texture changed. Sample B exhibited the highest degradation rate and exhibited a high degree ofdecomposition. The degradation rate can be summarized as Positive control>Sample B>Sample C>Sample A> Negative Control respectively. The main conclusion from this study is that the biodegradation of bioplastics materials strongly depends on both the environment in which they are placed and the chemical nature of the material.

Keywords: Biodegradation, Biobased film products, Composting environment