Bioplastic: Understanding the chemistry and its environmental impact

Pauline De Bigault De Cazanove*[1], Ruth Rose[2], Perry Higgs[3], and Marina Resmini[1]

[1]School of Physical and Chemical Sciences – Queen Mary University of London, Mile End Road, London E1 4NS, United Kingdom

[2]School of Biological Sciences [London] – Queen Mary University of London, Mile End Road, London E1 4NS, United Kingdom

[3]Symphony Environmental Technologies – 6 Elstree Gate, Elstree Way, Borehamwood, Herts, WD6 1JD, United Kingdom

Abstract

The impact and fate of plastic polymers in the environment is the subject of global concern, therefore leading to an search for viable alternatives. The novelty of the market has attracted the development of many products identified as bioplastics, often associated with terms such as biodegradable, compostable, or oxo-degradable. The degradation rate of a given product is closely dependent on the processing conditions including the decomposition media. The process is believed to be induced by environmental abiotic factors, that fragment the polymer followed by further biotic degradation by microorganisms. The interdependence of these mechanisms can be correlated to the modifications that occur during the process in the polymer matrix. Laboratory accelerated-weathering methods provide unique opportunities to evaluate the physico-chemical changes in plastics when exposed to different environmental stimuli. Understanding the fate of bioplastics in the environment is critical, and yet unknown, as their breakdown products may impact on biota, microbial communities, and more broadly on global biogeochemical cycles. In this project we are focused on the degradation profile of unaged and artificially aged polymers. A combination of UV irradiation and thermal exposure is used to obtain reproducible data consistent with natural weathering of plastic. FT-IR allows the quantification of carbonyl species induced by these processes due to varied chemical reactions. Another aspect of the project involves the in-vitro evaluation of the biodegradability of different plastic samples in a simulated aqueous media. Preliminary results demonstrate that the combination of photo- and thermal-degradation is an efficient method for artificial weathering and is promising to help predicting what would happen in the environment. The appearance of carbonyl species formed due to the chemical degradation of polymers provides evidence of further biodegradability by microorganisms. Different species of bacteria show distinct strategies of biodegradation according to the polymer type contained in the media.

Keywords: Bioplastic, artificial ageing, analytical techniques, biodegradation, environment

*Speaker