The Natural Breakdown of Plastic Wastes and the Emergence of Resultant Products: An Experimental Study

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Résumé

Once released into the environment, plastic waste goes through multiple natural weathering processes, most likely mechanical abrasion, and photochemical oxidation (Andrady., 2011). These phenomena contribute to many changes in polymer properties: (i) chemical changes, (ii) physical changes (Andrady., 2017), (iii) generation of low molecule weight products (i.e., microplastics and nanoplastics), and (iv) release of additives (Catrouillet et al., 2021). Often, Ultraviolet B radiation in sunlight and oxygen are the primary factors in outdoor polymer weathering. Accelerated indoor aging experiments on formulated plastic (polyethylene) samples were conducted using hydrogen peroxide and microwave irradiation to predict outdoor weathering behaviors based on laboratory aging data. FTIR spectroscopy was employed to monitor the modification of PE spectra during photooxidation. Different carbonyl products have been formed during the degradation of polyethylene-based plastics, including the carboxylic acids, the ketones, and the esters, peaking at about 1713 cm-1 , 1720 cm-1 , and 1735 cm-1 . The collected data was employed to calculate the carbonyl index (C.I), which was found to be 0.48 after 7 hours of microwave exposure. Furthermore, a quantitative investigation of the aqueous phase yielded intriguing findings: (i) an increase in the amount of organic carbon within the aqueous phase during the exposure period, provided by Total Organic Carbon (TOC) Analyzer, and (ii) a gradual rise in the quantities of

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additives released from the formulated plastic matrix under the effect of accelerated aging, as proved by ICP-MS quantification. Our investigation elucidates the impact of weathering on formulated plastics. The resulting data will provide valuable information on the outdoor weathering of plastic waste and its ultimate products.

Mots-Clés: Plastic aging