Photolysis of microplastics under ultraviolet radiation : greenhouse gas emissions.

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Abstract

Photolysis is the main factor leading to the degradation of plastic polymers. It depends on the type of plastic, especially on their ability to react to certain wavelengths of solar radiation. In this study, we aimed to understand how the photodegradation of microplastics, ranging in size from 1μm to 5mm, contributes to the production of greenhouse gases using an experimental approach. The plastics selected represent the main types in European demand: polypropylene (PP), low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyethylene terephthalate (PET) and polystyrene (PS). These polymers were exposed to simulated solar radiation in an artificial structure equipped with two ultraviolet (UV) lamps (300W/m2) providing a spectrum equivalent to solar radiation. The samples were exposed for 1, 2, 3 and 4 weeks. Photolysis induces molecular and structural degradation, revealed by Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and Gas Chromatography with Thermal Conductivity Detector (GC-TCD). Gas production was revealed for all types of plastic, with concentrations increasing as a function of degradation time. The results indicate that plastics emit carbon monoxide (CO), carbon dioxide (CO2), methane (CH4) and hydrogen (H2). These emissions vary depending on the type of plastic and the time of exposure to ultraviolet radiation. Therefore, the results reveal that plastics are a significant source of greenhouse gases.

Keywords: photolysis, microplastics, photodegradation, greenhouse gases, ultraviolet (UV), polypropylene (PP), low, density polyethylene (LDPE), high, density polyethylene (HDPE), polyethylene terephthalate (PET), polystyrene (PS)

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