Effect of simulated treatments and weathering processes on the aging of land-based microplastics

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After being released to the environment, microplastics can go through different aging processes that change their physical and chemical properties. These modifications are overlooked in many publications that use virgin microplastics in sorption and/or toxicity studies. Therefore, the main goal of this investigation is to test the degree of microplastics aging resulting from their exposure to ozone, UV light and simulated solar radiation, mimicking different effluent treatment processes or degradation due to environmental agents. In parallel, a three-month experiment was conducted for which the microplastics were exposed to real conditions of weathering, regarding temperature, sunlight, and humidity variations. All these experiments were performed for three polymer powders: low-density polyethylene (LDPE) with a mean particle size of around 500 µm, and polyethylene terephthalate (PET) and unplasticized polyvinylchloride (uPVC), both with a mean particle size of around 150 µm. The microplastic samples (virgin and modified) were analyzed by FTIR spectroscopy to infer about the intensity of oxidation, XRD for crystallinity characterization, and SEM to identify surface morphological changes. The Carbonyl Index, well described in the literature as a metric for the oxidation of polymers, was used here to quantify the changes in the chemical structure of the material. This allowed to estimate the aging evolution through exposure time, since samples were periodically collected for FTIR analysis. The results show that the three polymers are differently affected by the treatments tested. Furthermore, it can help us to understand what are the main aging mechanisms that can affect microplastics in urban environments and what modifications can result from those stressors, which can potentially lead to different impacts in the ecosystems and human health from those that are expected for virgin microplastics.

Keywords : LDPE , ozone , PET , solar radiation , uPVC , UV light

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