RESUMO - CONTAMINANTES EMERGENTES E AGROTÓXICOS

FROM PROPAGANDA TO REALITY: ABIOTIC DEGRADATION OF OXO-DEGRADABLE BAGS AND GENERATION OF MICROPLASTICS

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Currently, degradable plastic materials have occupied more and more space on commercial shelves and in society's daily lives. However, issues related to inadequate certifications regarding single-use utensils that claim complete degradation have been increasingly reported, and the incidence of greenwashing has increased quantitatively. Oxo-degradable polyethylene bags (OXO-PE) have been widely used as an “eco-friendly” alternative. However, there is insufficient evidence that these materials provide an environmental advantage over conventional polyethylene (PE-C) bags. This study evaluated the degradation and consequent microplastic generation from PE and OXO-PE commercial bags exposed to indoor and outdoor irradiation. Additionally, a sample OXO-PE bag was also degraded under simulated environmental water. In the lab, samples of three different OXO-PE and PE commercial bags measuring 6.5 x 6.5 cm were organized in glass Petri dishes and degraded in an accelerated aging chamber, equipped with three 36W UVA lamps with incident light of 501.7 W m-2. Experiments were carried out for 0-79 days, with continuous daily exposures of 8 h. The samples were cut into 5.0 x 2.0 cm for outdoor experiments and exposed to weathering for 0-90 days of degradation. The OXO-PE bag with the highest modification during indoor degradation was

employed for the degradation experiments in simulated environmental water. Initially, 350 mg of circular-shaped OXO-PE fragments with a diameter of 5 mm were added to 250 mL of filtered ultrapure water and then transferred to the same degradation chamber (same used in indoor degradation experiments). Aquarium air pumps were used to simulate natural agitation and aeration. The experiments were conducted for 0-100 days with 10 hours of continuous irradiation. Subsequently, the samples were filtered to separate plastic particles for analysis. Structural changes in all plastic samples were evaluated through visual changes and chemical characterization using Fourier transform infrared spectroscopy (FTIR-ATR). For the indoor degradation, only PE and 2/3 of the oxo-degradable bags showed color change (they turned slightly opaque and yellowish), which increased with exposure time. 2/3 of oxo-degradable samples had small cracks that followed until fragmentation. However, only one sample produced about 18 microplastic particles in 54 days and approximately 43 particles in 79 days. Likewise, the longer the exposure time, the smaller the size of the fragmented particles. Unlike the samples degraded in the accelerated aging chamber, the OXO-PE samples degraded in the simulated environmental water did not show significant visual changes (surface yellowing, macrocracks, or fragmentation) during the analyzed period. This characteristic may be related to less exposure to light due to the absorption of light by water molecules. For the outdoor degradation, only 2/3 of the oxo-degradable bags showed color change (they turned slightly opaque and yellowish). Additionally, after 60 days of exposure, 2/3 OXO-PE samples showed small cracks that continued to fragment. Furthermore, 2/3 of the OXO-PE showed biofilm formation on the surface after 60 days of exposure and PE after 90 days. The OXO-PE samples had more significant changes compared to the PE sample. The FTIR spectra showed the characteristic bands of PE represented by the methylene group between 2922 – 2910 cm-1 (CH2 elongation – asymmetrical) and between 2849 and 2840 cm-1 (CH2 elongation – symmetrical). It was also observed in the region from 1800 cm-1 to 1650 cm-1, which increase in intensity, referring to the carbonyl region showing surface oxidation in all samples. The carbonyl index of all samples increased as the exposure time to degradation increased. The OXO-PE bags differed in degradation levels even when subjected to the same processes. In addition, one of them showed similar behavior to PE-C. However, only one type of OXO-PE formed microplastic particles.

Palavras-chave: plastic degradation; oxo-degradable bags; microplastic;.