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Behavior of Commercial Microplastic Derived DOM under UV Irradiation and Its Disinfection Byproducts Formation Characteristics

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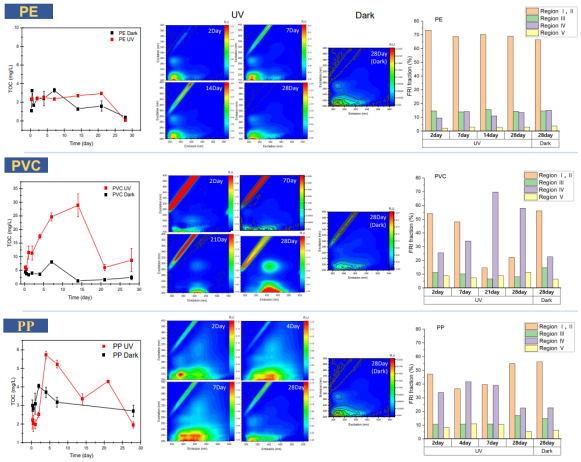

Microplastics (MP) are synthetic polymer compounds having sizes with less than 5 mm, present almost everywhere in the global environment, and are emerging as persistent pollutants. MP has received extensive attention due to its effects on the ecosystem. MP can be accumulated in the food chain through ingestion of it by aquatic organisms during its transport in the natural environment. Another important exposure pathway of MP to terrestrial organisms include consumption of dissolved organic matter (DOM) leached during weathering of MP in the natural and engineered systems. Further, the MP-derived DOM (MP-DOM) can a precursor for the formation of disinfection byproducts (DBPs) during disinfection processes. The objectives of this study were to identify the behavior of commercial polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), and polystyrene (PS) microplastic-derived DOM under dark and UV irradiation conditions, and to investigate its DBP formation characteristics. Initially, DOM leaching experiments were conducted for 14 days with an MP dose of 8 g/L under the UV irradiation at 2.7mW/cm^2(UVA). The highest concentrations of DOM leached from individual MP were 6.3, 5.72, 24.62, and 1.49 mg/L for PP, PE, PVC, and PS, respectively. This confirmed that the irradiation of UV promoted DOM leaching from MP. The optical properties of DOM were studied by building fluorescence excitation-emission matrix (EEM) of DOM generated from the UV weathering. The DOM leached from PVC and PP under the UV irradiation showed pronounced changes in properties than the DOM under dark conditions. Proteins and fulvic acid-like substances were dominant in these DOMs originated from PVC and PP when UV irradiated. The DOM concentrations generally decreased over time during the irradiation. It was confirmed that photolysis was responsible for the decrease. In addition, the properties of MP used during leaching were analyzed using Fourier transform infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM), and X-ray diffraction (XRD). The changes in the optical properties of the MP-DOM after they were chlorinated were also investigated. Finally, chlorinated DBPs formation potentials were tested.