Fluorinated environmental contaminants: Discovering relationships between Fluoropolymer-based microplastics and polyfluoroalkyl substances (PFASs)

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Abstract

While perfluorinated polymers such as polytetrafluoroethylene (PTFE) is considered to be resistant to natural weathering, it can still be degraded over time, during which it may release harmful short-chain polyfluorinated alkyl substances (PFASs). Additional concern regarding PTFE particles is their role as vectors for toxic trace organic compounds, particularly towards co-existing fluorinated compounds. Our research focuses on examining PTFE potential to act as source and sink of PFAS, including further implications on human health. Based on previous degradation protocols developed by our group (Sarkar et al., *ES&T*, 2020), (N1) we degrade raw PTFE particles in a set of accelerated weathering laboratory conditions. In this procedure, pristine PTFE particles are exposed to various oxidation, mechanical and repeated thermal treatments. Then, we evaluate the leaching of short-chained PFASs, sorption potential towards co-existing PFASs, and the corresponding desorption potential in realistic post scenarios of transport from environmental media to biological media following ingestion by living forms. Lastly, the potential toxic effects of PTFE particles, PFAS, and PTFE-sorbed-PFAS are investigated using a single-cell model of Caco2 (human colon epithelial cell line).

Our results showed that when pristine PTFE particles suspensions were probe sonicated (i.e., mechanically treated(N2)), the number of particles was doubled. The ATR-equipped Fourier transform infrared spectrometry (FT-IR) spectra of ozone treated raw PTFE particles (_˜17,008 mg/L) showed new peaks at approximately 1100, 1700 and 2900 cm–1, which were not observed in the raw PTFE spectra. These new peaks are respectively associated with C-O stretching, carboxyl groups, and O-H stretching. Therefore, we conclude that PTFE does degrade in extreme condition and may result in PFAS release. Currently, the project is being conducted in parallel at the technical university of Munich (sorption studies) and at Tel Aviv University (toxicity studies) to shed light on the relationships between these two emerging fluorinated contaminants.

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