Optimizing spectral classification and oxidation estimation of environmental Microplastics

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Abstract

Microplastics (MPs) research has been challenging due to the wide range of methodologies that have been applied for sampling, extraction, counting and polymer type identification. Identifying MPs with microscopy only can yield to false positive and false negative results. Thus, polymer type identification is required to confirm that particles classified as MPs are indeed plastic polymers. The accurate identification of the small and weathered microplastics found at sea is critical. Therefore building spectral libraries based on weathered MPs is important. Here, we performed an intercalibration exercise using 200 spectra of sea surface floating microplastics ($> 300\mu$m) applying two different FTIR spectrometers. Differences and similarities of the results were investigated using various spectral preprocessing methods and tools and checked against various libraries. In addition, for a total of 2000 spectra from marine floating microplastics the carbonyl index (CI) of polyethylene (PE) polypropylene (PP) and Polystyrene (PS), including a diversity of sizes, and shape types, was calculated, using two different CI measurement techniques as described in the literature. The CIs of marine floating MPs were compared with those from literature data from accelerated ageing experiments and from MPs of known 'age'. CI calculation of the specified area under band (SAUB), revealed high variability ranging from 0.04 to 5.98 for the PE and 0.06 to 3.96 for the PP. The percentage of PE particles with SAUB ratio between 0.04 - 0.44 was 28%, between 0.45 - 0.84 it was 55% and larger than 0.84 17%. Similarly for PP these percentages were found 45%, 48% and 7% respectively for the three CI ranges. The results demonstrate different trends in the CIs for PE and PP, while comparison with experimental data or with MPs of known 'age' is not straightforward; implying that oxidation of plastics in the environment is a complex process.

Keywords: Polymer type, Weathering, sea surface floating microplastics

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