Homoaggregation of environmentally realistic polystyrene microplastic

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Abstract

Aggregation has a significant control over the fate of plastics in natural waters. It can increase the rate of settling and deposition of microplastic (MP), thus reduce bioavailability and ecotoxicologial effect of MP on pelagial organisms. Homoaggregation, the aggregation of the same kind of particles, is poorly understood in the case of MP.
In our study, a sample of polystyrene microplastic (PSMP) was obtained from cryomilled daily-use plastic products. For characterization of PSMP, infrared spectroscopy, thermal analysis, and scanning electron microscope (SEM) analysis were used. The particles varied in size (0.0001 - 0.5 mm), shape and morphology, thus reflected the MPs occurring in the environment. Homoaggregation was studied in deionized water and in saltwater by the preparation of PSMP suspensions (100 mg/L). For investigation of PSMP suspensions and homoaggregates, zeta potential measurements, optical microscope and SEM analyses were performed. Zeta potential of PSMP suspended in deionized water and saltwater was 0.5 mV and -27 mV, representing, highly unstable and moderately stable suspensions, respectively. Indeed, the homoaggregation of PSMP particles occurred only in deionized water, while in saltwater the PSMP showed affinity for stabilization. Homoaggregates were of irregular shapes and rough morphology with 2–8 mm in size. Stability and sinking behaviour of homoaggregates as they descended through two-layered liquid composed of deionized water and saltwater were analysed in a settling column using particle tracking and image analysis methods. The settling experiments demonstrated that aggregates were stable during sinking, i.e. did not break down, in deionized water, saltwater, as well as at the transition between these two layers.
The PSMP aggregation is mostly controlled by physical processes with particles attachment enhanced by rough morphology. In contrast to nanoplastic homoaggregation widely reported in literature, the PSMPs would be more likely to aggregate among themselves in with low ionic strength and conductivity water.

Keywords: homoaggregation, polystyrene, microplastic, ionic strength

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