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Spatial-Seasonal Variation in Microplastic Distribution at the Han River Estuary to the Coastal Area of Incheon, Korea

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Extended Abstract

As microplastics, which are synthetic polymers of less than 5 mm [1], have been emerged as a global environmental issue, lots of research have been conducted on spatial distribution and ecological impact in the marine [2-5], freshwater [6-8], and terrestrial environments [9, 10]. Several studies are also being investigated in the transition zone between freshwater and marine environments [11]. However, there are still insufficient data to analytically survey their distribution of microplastics in there. In 2020, therein, the spatial-seasonal distribution of the suspended microplastics in the range from 330 μm to 5 mm has been monitored in the Han River Estuary extending to neighbored coastal area, Korea. For this purpose, microplastic samples have been collected from a total of 11 sampling stations located along the downstream of the Han River, Ganghwa Island, the Coast of Incheon, and Deokjeok Island. In each location, sampling has been carried out using a Manta trawl net (mesh size of 330 μm) while continuing to tow horizontally for 10 min. The collected samples were sieved through a 2 mm standard sieve, after which bigger pieces more than that were rinsed with distilled water and dried, while smaller particles were pre-treated by wet oxidation with hydrogen peroxide (H_2O_2) followed by density separation process with zinc bromide ($ZnBr_2$) solution. Such separated unknown particles, possibly microplastics, were identified by Fourier transform infrared (FTIR) spectroscopy (VERTEX 80V, Bruker, Germany; Spotlight 400 FT-IR Imaging System, Perkin Elmer, USA). As a result, the average annual abundance of microplastics was estimated to be (2.15 ± 0.54) particles/m^3 in downstream of the Han River, (2.11 ± 0.60) particles/m^3 in Ganghwa Island, (6.12 ± 0.96) particles/m^3 in the Coast of Incheon, and 1.71 particles/m^3 in Deokjeok Island, respectively. Among them, Ganghwa Island, was found to be the most abundance possibly inflowed from land-originated marine debris, fishing activities, and their own hydrogeological contribution. In the case of Deokjeok Island, which is relatively farthest from the land, the abundance of microplastics was at the lowest level observed among others. Nonetheless, it was found that PS has been rapidly increased in July and August at the topmost extent due to probably lose or erroneous abandon of various fishing gears made in PS because of seasonally occurred heavy rains and highly rising sea waves. In this regard, for nearer the land of watershed, the spatial distribution of microplastics revealed in the order of polyethylene (PE) > polypropylene (PP) > polystyrene (PS) > copolymers (including plastic additives) > polyethylene terephthalate (PET)/polyester. In contrast, for the farthest as of Deokjeok Island, it showed that PS was composed of at the highest proportion of 58.5% among others. In the aspect of size distribution, type of microplastics showed at the different manner as PS was mainly ranged in 2~5 mm, while PE and PP were dominantly sized in 330 μm~2 mm. In conclusion, it was confirmed that microplastics could be detected more in coastal water close to land, and there is a clear difference depending on the inflow routes of microplastics and formation mechanism. This study would be applied to the effective management of microplastics for a sustainable environmental system.

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