The history of microplastics occurrence in the sediments affected by treated effluents

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Abstract

Only few microplastic studies have utilized the full potential of sediment samples to assess the microplastics pollution of aquatic environments. This study focused on the abundance and types of microplastics in bottom sediment layers collected from four sites of Lake Saimaa, which receives treated effluents from the main wastewater treatment plant (WWTP) of Mikkeli, Finland. Sediment samples were collected with a Limnos sediment core sampler, and they were separated into 1–2 cm layers. The Cs-137 activity was then measured for each layer. The chronological structure was utilized to relate the detected microplastics with their sedimentation years (1990, 2000, 2010, and 2018). The respective samples were pretreated with oxidation and density separation (1.4 g/cm3), and the resulted microplastics larger than 100 μ m were identified with a Raman microscope.

The average microplastics concentrations (\pm standard error) for the studied years of 1990–2018 varied from 890 (\pm 200) n/kg dw to 4400 (\pm 620) n/kg dw, being significantly highest closest to the discharge site of the WWTP. At three sites, the highest concentrations were detected for the sediment layers representing the year 2010. The detected microplastic concentrations suggested that microplastic pollution has slightly increased during recent decades, which is in line with the globally increased consumption of plastics in general. Furthermore, near the discharge site, microplastic fibers covered 77% of all detected microplastics, and 90% of those were identified as polyester. The high concentration of polyester fibers close to the discharge site of the WWTP is in line with the global production of polyester, as polyester covers over half of all produced fibers (Opperskalski et al., 2019). According to this study, at least part of the microplastics discharged from WWTP can be trapped in the lake sediment near the discharge site, which reduces the microplastic load discharged to the marine environment.

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