Effectiveness of Wastewater Treatment Plants in Removing Microplastics

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The accumulation of microplastics, defined as plastic particles with a diameter < 5 mm, in freshwater and marine ecosystems is a growing concern. Fauna across a range of feeding guilds can ingest microplastics, which serve as vectors for chemical toxins and viral and bacterial pathogens. The goal of this study was to document the extent of microplastics removal across different types of wastewater treatment plants (WWTPs) to understand the effectiveness of various unit processes in removing microplastics. Samples were collected at different locations at three WWTPs, including a WWTP using secondary treatment (activated sludge) as the final step (plant A), a WWTP using tertiary treatment (filtration) as the final step (plant B), and a novel membrane bioreactor WWTP (plant C). After sieving the samples, microplastics >20 μm were quantified using a stereomicroscope and categorized (fibers, fragments, filaments, paint chips, and microbeads). In all three WWTPs, most of the microplastics were removed through preliminary and primary treatment. Limited additional removal was accomplished through secondary treatment, but substantial removal was obtained by tertiary treatment and the membrane bioreactor system. The overall removals of microplastics at plants A, B, and C were 95.6%, 97.2%, and 99.4%, respectively. In addition, plants B and C exhibited greater removal of larger microplastics (e.g., microbeads) than plant A, and the majority of microplastics remaining in the effluents of plants B and C were fibers. The implementation of tertiary filtration or membrane bioreactor systems in existing WWTPs will result in the highest removal of microplastics.