Can WasteWater Treatment Plants (WWTP) clean the sewage for microplastics? (using a newly developed filtration instrument)

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Introduction
There has been an increasing focus worldwide on the plastic contamination of the Earth, and in recent years MicroPlastics [MP] has also been added to this focus. However, since early 1970ties the environmental pollution of MP has been observed in natural compartments, initially in the marine environment in early 1970ties (Carpenter, Anderson et al. 1972, Kartar, Milne et al. 1973, Morris, Hamilton 1974, Kartar, Milne et al. 1973, Morris, Hamilton 1974). During later years also in the terrestrial (Horton, Walton et al. 2017, Duis, Coors 2016), and more recently in the atmospheric compartment (Cai, Wang et al. 2017, Dris, Gasperi et al. 2016). Estimates shows that between 4.8 and 12.1 million tonnes MP are entering the marine environment annually (Jambeck, Geyer et al. 2015), and the degenerative nature of most MP prohibits finding of the potential point sources. However, it is more and more accepted that MP can have serious concern for humans and other species. Focus on hubs for translocation of MP between compartments is increasing. Some research indicate that Waste Water Treatment Plants [WWTPs] acts as such a hub, both between terrestrial-marine (Dyachenko, Mitchell et al. 2016) and terrestrial-terrestrial compartments (Horton, Walton et al. 2017, Dyachenko, Mitchell et al. 2016). The focus for this paper is two folded: (1) Presentation of a new state-of-the-art sampling device, and (2) water filtering results from the Danish WWTP in Herning.

Sampling Device
The developed device for filtering high volume flow were inspired by the work by Ziajahromi et al. (2017) and Talvitie et al. (2017) see Figures 1a,b. Figure 1c shows the new developed filtration device.

Experiment/Results
The new sampling device has been tested at Herning WWTP (Denmark). The experiment was conducted during April and May 2017, where a series of test run of was conducted. The sample was taken just after the last sewage treatment at the WWTP and before in enter into the nature. During the experiment a process flow were measured between 6.96 and 18.3 L/min dependent on the elevation of the device to the drainage. A volume of approximately 1000L of sawage water were filtered in approx. 1.3 hours. In Table 1 is the total number for MP split into colours and appearance presented. The total number of particles is calculated from the assumption that the sample is homogeny in terms of distribution of the particles throughout the sample.

Discussion and Conclusion
Various studies of WWTPs ability to clean sewage have been carried out. A Finnish pilot study (HELCOM, 2017) concluded that even though retention rates of different types of MP to the marine environment are relative high (95.63-96.57 %) these particles still potentially enters the environment as they resides in the sludge sediment for later distribution to agricultural soils etc. Recently, a large Danish study funded by the Danish EPA EPA (2017) concluded that average emission of MP (size range 20-500 \(\mu m\)) from a Danish WWTP to the marine environment
could be calculated to 0.3% (with 25th and 75th percentiles of 0.0% and 0.7%) of MP mass entering a plant. In quantifying numbers this is a median of 5800 particles/L or 0.02 mg/L (EPA 2017). Their study affirms that current practise is sufficient in preventing MP entering marine environment from WWTPs. A comparison of these studies together with this work shows diverse samplings sizes, methods and results. However, the main conclusion form HELCOM (2017) is in alignment with our results: WWTP has problems with cleaning sewage for the smallest particles such as MP. This is in contradiction with the large Danish study (EPA, 2017, and it can be argued that the samplings size used in the large Danish study is not representation enough as it seems like smaller sample sizes (4.1-81.5 L) has been processed in that study. The developed instrument has shown potential in delivering suitable output. In the future further test of the new device will be conducted, i.e. test of the efficiency of the instrument to deliver particles in size fractions of interest, etc.


EPA (ENVIRONMENTAL PROTECTION AGENCY), 2017. Microplastic in Danish wastewater. Sources, occurrences and fate. Denmark: The Danish Environmental Protection Agency.


