Unraveling the sources of marine microplastics: your daily contribution?

Van Cauwenberghe Lisbeth[1], Wout Van Echelpoel[1], Kris De Gussem[2], Greet De Gueldre[2], Michiel Vandegehuchte[1,3], and Colin R. Janssen[1]

[1] Laboratory of Environmental Toxicology and Aquatic Ecology (GhEnToxLab Unit), Ghent University, Jozef Plateaustraat 22, B-9000 Ghent, Belgium
E-mail: lisbeth.vancauwenberghe@ugent.be

[2] Aquafin NV, Dijkstraat 8, B-2630 Aartselaar, Belgium

[3] Agentschap Natuur en Bos, Koning Albert II-laan 20 bus 8, B-1000 Brussel, Belgium

Microplastics, small plastic particles (< 1mm or < 5mm) are ubiquitously present in the marine environment. They have been accumulating there for decades, and can now be found at the sea surface, in the water column, sediment and in marine biota such as bivalves. A recent study estimated that approximately 4.9 trillion microplastic particles (0.33 – 4.75mm) are floating around in the world's seas and oceans, representing 3.6 10^4 tonnes of plastic (Eriksen et al., 2014). These microplastics have different origins, including the washing of synthetic garments, the use of microbead-containing cosmetics and, perhaps the best known source, the degradation of large plastic litter.

Although the origin of marine macroplastic pollution is related to both land- and water-based activities, land-based sources are considered to be more significant and are estimated to account for 80% of the litter detected in the marine environment (Sheavly and Register, 2007). Especially rivers are considered continuous suppliers of this type of waste. For microplastic pollution, such estimations do not exist. Yet, there is a growing body of evidence that microplastics are present in freshwater systems as well and thus contribute to the marine microplastic load. In this respect, sewage treatment plants (STPs) are regarded as major sources of such microplastics as our domestic sewage is polluted with microbeads used in personal care products and fibres originating from the washing of synthetic clothes.

In order to assess the contribution of an STP to microplastic pollution of rivers, and eventually the marine environment, an STP in Destelbergen (Gent, Belgium) was examined. Influent samples had an average microplastic content of 17 ± 7 plastics.L^{-1}. A decrease in the microplastic load was observed in the effluent which had on average 5 ± 1 plastics.L^{-1}. This corresponds to a removal efficiency of 80%. We calculated that this single STP has a daily discharge of $2.1 \cdot 10^9$ plastics.d^{-1} (i.e. 1400 plastics.inhabitant^{-1}.d^{-1}). Using these figures, a daily discharge of roughly 14.6 billion plastics.d^{-1} is derived for the whole of Flanders ($6.5 \cdot 10^6$ inhabitants). This high discharge is reflected in the microplastic abundance detected in the surrounding freshwater environment, i.e the receiving brook and Scheldt River: here, on average 6 ± 2 and 7 ± 2 plastics.L^{-1} were detected. In freshwater sediments, the lowest abundances observed (ranging from 4,148 plastics.kg^{-1} to 15,111 plastics.kg^{-1}) were higher than those reported for marine sediments.

Here, we demonstrated that STPs, but ultimately households, play an important role in the discharge of microplastics into the aquatic environment. Even though 80% of the particles are retained during the sewage treatment process, discharges into the environment remain high, with billions of particles being released on a daily basis. Since microplastics do not belong in sewage tackling their input into the environment at the source (e.g. a ban on microbeads or improved technologies for laundry washing) is the only (sustainable) way forward.

References

Eriksen M., L.C.M. Lebreton, H.S. Carson, M. Thiel, C.J. Moore, J. Borerro, F. Galgani, P.G. Ryan, and J. Reisser. 2014. Plastic pollution in the world's oceans: Mmore than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PLoS ONE 9: e111913. doi:10.1371/journal.pone.0111913

Sheavly S. and K. Register. 2007. Marine debris & plastics: environmental concerns, sources, impacts and solutions. Journal of Polymers and the Environment 15:301-305.