Microplastics in urban sources and receiving water within an urban area

RACHID DRIS[1*], JOHNNY GASPERI[1], CECILE MIRANDE[1], MOHAMED SAAD[1], VINCENT ROCHER[2], ALAIN RABIER[3], BRUNO TASSIN[1]

[1] Université Paris-Est, LEESU (laboratoire eau, environnement et systèmes urbains), UMR MA 102, 61 Av Général de Gaulle, 94010 Créteil, France,

[2] SIAAP (syndicat interdépartemental pour l'assainissement de l'agglomération parisienne), Direction du Développement et de la Prospective, 82 avenue Kléber, 92700 Colombes, France

[3] Département du Val-de-Marne - DSEA (Direction des Services de l'Environnement et de l'Assainissement), 2 avenue des Violettes, ZAC des Petits Carreaux, 94385 Bonneuil-sur-Marne, France,

*drisr@leesu.enpc.fr

Abstract

Microplastics have been defined as particles with the larger dimension smaller than 5 mm (Hidalgo-Ruz et al., 2012). To date, marine plastic pollution has been well documented while there has been limited focus on the continental contamination (Cole et al., 2011; Dris et al., 2015). Moreover, the sources and pathways of these particles in an urban context remain largely unknown.

This study aims at investigating several sources of microplastics in an urban environment and assessing the microplastic concentrations within the Seine River in the Parisian metropolitan area.

For urban sources, atmospheric fallout, wastewater disposal and stormwater were considered.

- Atmospheric fallout was collected in two different sites, one urban (during 1 year) and one sub-urban (during a half year), through a collection funnel.
- Microplastics in wastewater treatment plant (WWTP) influents and effluents were analyzed in three 24-hour averaged samples. This plant uses a biological treatment employing biofiltres.
- Stormwater was also analyzed. It was collected at the catchment outlet of a small sub-urban catchment during three rain events.

In parallel to urban sources investigation, contamination of surface water was also examined. Therefore, surface water was collected using two different nets. A Manta net with 330 µm mesh size was towed by a boat in three points of the Seine River during 15 minutes. This was performed during two different campaigns. A plankton net with 80 µm mesh size was used from bridges in a stationary position to collect water. This was done during 9 campaigns on, i.e, 4 stations in the Seine River and one point in the Marne River.

In all samples, the collected water was filtered through glass fiber GF/A Whatman® filters (1.6 µm) and filters were observed with a stereomicroscope Leica MZ12 coupled with a software for image analyzing to account microplastics and measure their sizes.

For urban sources, most of microplastic observed are fibers. Significant levels are observed in total atmospheric fallout in the urban site (2-355 particles/m^2/d) and the sub-urban one (21-127 particles/m^2/d). Their temporal variation is strongly influenced by rain events suggesting that the microplastic wash out could be a major route of deposition. High levels of fibrous plastics are found in wastewater (260 – 320 x10^3 particles/m^3). Outlet concentration is significantly lower 14-50 x 10^3 particles/m^3, suggesting a transfer to the sludge. Concentrations of microplastics in stormwater are in the same order of magnitude as the concentrations in the WWTP effluents (28-60 particles/m^3).

The contamination of the Marne and Seine Rivers by microplastics was observed. Microplastics collected by the plankton net are nearly all fibrous while only half of the particles collected in the manta net are fibers (others are fragments or spherules). This difference in the shape characterization of the particles collected is due to the high gap between the volumes collected (2 m^3 for plankton and 200 m^3 for manta nets). However, a high proportion of fibers pass through the manta net due to its mesh size. Concentrations vary between 0.28 and 0.47 particles/m^3 (Manta) and between 2 and 441 particles/m^3 (plankton net). No clear correlation with the river flow or the suspended particular matter was observed.

References

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