

First assessment of sources and fate of macro- and
micro- plastics in urban hydrosystems: Case of Paris
megacity

Par Rachid DRIS

Thèse réalisée au Laboratoire Eau Environnement et Systèmes Urbains, UMR MA 102

Dirigée par Bruno Tassin et Johnny GASPERI

À soutenir le 09 décembre 2016 à l'École des Ponts ParisTech

Jury :

M. C. LAFORSCH	Professeur, Université Bayreuth	Rapporteur
M. F. DE ALENCASTRO	Maitre d'enseignement et de recherche, EPFL	Rapporteur
M. F. GALGANI	Chercheur, IFREMER	Examineur
Mme. F. LAGARDE	Maître de conférences, Université du Mans	Examineur
Mme. I. PAUL-PONT	Chercheur, Université de Bretagne Occidentale	Examineur
M. V. ROCHER	Chef de service R&D, SIAAP	Examineur
M. B. TASSIN	Directeur de recherche, ENPC	Co-directeur de thèse
M. J. GASPERI	Maître de conférences, UPEC	Co-directeur de thèse

Abstract

Plastic pollution has been widely studied in marine environment since 1972 and mostly since 2004. Investigations on plastic pollution in freshwater and especially in urban catchments just started at the beginning of the decade, and urban plastic pollution sources and its related fluxes in rivers remains mainly unknown. Thus a specific attention should be paid to the plastic contamination in catchments exposed to severe anthropogenic pressure, especially within the urban areas. This PhD thesis focuses on the case of the Paris agglomeration and its impact on the Seine River. A double approach was carried out as both macro- (>5mm) and micro- (<5mm) plastics were considered.

The amount of macroplastics conveyed by the Seine River was estimated with a field study and with a theoretical approach.

Regarding microplastics, fibers (made with synthetic but also man-made polymers) and fragments were both investigated in different compartments of the urban system. The study focused on the air compartment (indoor and outdoor air as well as atmospheric fallout), the sewer system (from the washing machine disposals to the WWTP influents and effluents), and the inputs during wet weathers periods, i.e, runoff and combined sewer overflows. Fibers and fragments were also examined on the Seine River.

This work aimed at providing relevant methodological keys to address sampling of microplastic in rivers. Two mesh size nets were tested (80 μm vs. 300 μm). The homogeneity of fibers distribution in rivers was also verified as the short term temporal and spatial variabilities were evaluated. In order to highlight the potential impact of the Paris agglomeration, a monthly monitoring on 5 sites upstream and downstream Paris was carried out as well.

This thesis mainly highlighted the ubiquity of fibers in all compartments. Fibers were predominant in comparison to fragments in all compartments. Combined sewer overflows exhibited particularly high amounts of fragments. On the other hand, the flux of microplastics in the Seine River was proved be negligible in terms of mass in comparison to macroplastics. This study is also the first one showing that the atmospheric compartment needs to be considered as a potential significant source of microplastics.