

An overview of the parabens, triclosan and triclocarban contamination in the continuum greywater – surface water

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The use of personal care products (PCPs) is suspected to be part of the chemical pollution of surface waters. Among these chemicals, parabens (PBs), triclosan (TCS) and triclocarban (TCC) are widely used in the formulation of PCPs but also in sportive clothes, plastic objects, kitchenware, pharmaceuticals and food products as antiseptic or conservative. They are found ubiquitously in surface waters worldwide and thus becoming of increasing concern due to their wide utilization and their potential negative effect on aquatic ecosystems as endocrine disruptors or induction of antibiotic resistance. This study investigates the dynamic of these substances from their household uses to their releases in the river, in order to propose solutions to mitigate them. Therefore, the continuum “house - sanitation systems – river” at a large scale, a heavily urbanized but weakly industrialized area, the Paris conurbation, was considered: (i) to find the origin of the contamination in greywater; (ii) to understand their transport in the sanitation system and the wastewater treatment plant (WWTP); and (iii) to assess the contamination of both the Seine River and the discharges under dry and wet weather periods. With the help of the City of Paris and the Public Sanitation of the Paris conurbation (SIAAP), a comprehensive sampling campaign has been conducted. Five types of greywater were sampled: dishwasher (n=6), manual dishwashing (n=5), washing machine (n=11), showers (n=19) and washbasin (n=5). Domestic wastewaters from hospital (n=5), hair salon (n=23) and two Parisian districts (n=15) were also studied. The main seven Parisian sewer trunks (n=39) were considered as they represent the practices of about 8 million inhabitants. Concerning the Seine River, two points were sampled up and downstream Paris (n=15). The main water discharges from WWTP under dry weather (n=11) and from combined sewer overflow (CSO) under wet weather (n=12) were evaluated.

Results are given in Table 1. The key lesson highlighted by this study is that greywater strongly contributes to the contamination of wastewater. However PCPs are not the only source of parabens and triclosan in wastewater: Greywater from washing machine appeared as concentrated as that from shower water. Wastewater from hair salon is strongly contaminated compared to domestic wastewater. Urban discharges under wet weather period constitute a major source of contamination for the receiving waters with respect to the measured levels. The discharges from sanitation, during dry and wet weather periods, could explain the increase of concentrations of parabens, triclosan and triclocarban in the Seine River before and after Paris.

Table 1. Concentrations in the dissolved part of the samples

Median (d10 – d90)	MeP (ng/L)	EtP (ng/L)	PrP (ng/L)	TCS (ng/L)	TCC (ng/L)
Greywater (n=46)	1 800 (180 – 101 000)	240 (27 – 1 500)	250 (3.0 – 4 300)	470 (36 – 2 300)	<LOQ
Hair salon (n=11)	16 500 (5 000 – 90 000)	5 500 (1 200 – 17 000)	2 000 (690 – 5 400)	170 (82 – 260)	38 (27 – 50)
Beauty salon (n=12)	2 000 (600 – 6 400)	3806 (110 – 1 200)	780 (490 – 2 600)	280 (180 – 370)	85 (16 – 140)
Hospital (n=5)	170 (24 – 2 800)	120 (68 – 1 200)	300 (170 – 1 000)	180 (60 – 500)	23 (10 – 33)
Parisian district (n=15)	3 600 (420 – 8 900)	1 500 (69 – 2 500)	900 (120 – 2 200)	210 (49 – 790)	42 (15 – 80)
Sewer trunks (n=17)	2 900 (1 520 – 5 900)	1 200 (760 – 2 700)	1 100 (790 – 2 200)	1 300 (1 200 – 1 400)	39 (18 – 63)
WWTP discharges (n=11)	35 (21 – 47)	19 (12 – 73)	21 (8 – 85)	78 (39 – 130)	6.8 (4.6 – 10)
CSO (n=12)	1 800 (270 – 4 300)	480 (98 – 1 500)	380 (89 – 780)	110 (50 – 380)	24 (16 – 33)
River before Paris (n=5)	3.6 (2.6 – 5.7)	1.0 (0.9 – 1.7)	1.6 (1.1 – 2.8)	16.8 (7.4 – 60)	1.3 (1.1 – 1.7)
River after Paris (n=5)	26 (6.7 – 140)	6.0 (3.5 – 39)	5.4 (2.6 – 46)	17 (5.2 – 68)	2.3 (2.1 – 2.8)