

Mobilization of PPCPs in a combined sewer during rain events

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1. Introduction

The combined sewers carry an important environmental problematic during the rain events owed principally to the CSOs (Combined Sewer Overflows). These imply a loss of efficiency of the system and an impact in the aquatic receiver. The new designs in urban drainage engineering are fundamentally motivated by the new set of protection aims of the aquatic system that there imposes the European Water Framework Directive.

The studies of pollutants associated with the mobilization in rain events of sediments accumulated in the sewer during the antecedent dry period have centred for the most part on the "conventional" pollutants (COD, suspended solids, heavy metals, etc); nevertheless, they exist a great quantity of chemical products that include both the pharmaceutical products and the used ones in the personal care (PPCPs), which also they receive the name of "micropollutants" (due to the orders of magnitude of concentrations in the waste water during dry time, of ppb, ppt or minors) or "emergent pollutants" (due to the fact that his study is recent), and that are spilt to the sanitation sewers.

The concept of "micropollutants" is very wide and includes a great variety of substances that normally are below the habitual ranges considered by the quality procedures (mg/L). In case of the PPCPs (Personal Pharmaceutical and Care Products), the concentrations usually found in the urban waste water of dry time are in the range of the ppb ($\mu\text{g/L}$) or ppt (ng/L). The documentation that exists on discharged quantities and environmental impacts of these substances is still scanty for what there does not exist legislation relating to parameters neither of spillage nor of quality of the aquatic receiver system.

In the last years there have appeared numerous studies realized specially in the USA and Europe which have detected a great number of these compounds both in waste water and in underground (aquifers) and superficial (rivers and lakes) waters. The motives that originate this worry are based on the following points: i) a lot of these substances are designed to produce biological effects (particularly the pharmaceutical compounds); ii) many of them are persistent; iii) they can have environmental negative effects enclosed to very low levels, in order of parts per billion or trillion ($\mu\text{g/L}$ or ng/L , respectively), specially on the aquatic life and; iv) potentially they have accumulative and synergistic effects when they combine each other.

Nevertheless, the existence of studies on the mobilization of this type of pollutants in rain events associated with the flush of sediments in combined sewers is practically void. The major part of this pollution could be discharged to the aquatic receiver system by CSO events. This article presents a study in a combined sewer basin of the city of Santiago de Compostela placed in the north of Spain, in which there is analyzed the behavior of 7 of the PPCPs most important and known worldwide in several rain events. The PPCPs selected for the study are: HHCb (galaxolide), AHTN (tonalide),

ibuprofen, diclofenac, carbamazepine, 17- β -estradiol and caffeine. Hydrographs and polutographs (particulate and dissolved forms) will be presented. Even meant concentration (EMC), Maximum event concentration (MEC) and Mass First Flush Ratio Calculation (MFF) are studied for each pollutant.

2. Materials and methods

A section of control has installed in the final part of the combined sewer of the basin of the "Ensanche" in Santiago de Compostela that contains a Flowmeter Sigma 950 area - speed, an Automatic Sampler Sigma 900 and one module of data communication by GPRS, which transmits the registers measured (flows and levels) on-line.

The analytical method used for the determination of the studied PPCPs is Solid Phase Extraction (SPE) coupled with High Performance Liquid Chromatography (HPLC) and Mass Spectrometry (API 3200 triple quadrupole) operating in MRM mode.

3. Results and discussion

The PPCPs mostly presented in particulate form suffer an important mobilization during the episodes of rain.

4. Conclusions

This paper presents the behavior of the PPCPs studied in a combined sewer and reveals the need of this type of drainage systems is provided with the necessary elements to manage adequately this pollution in rain events.

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6. References

- Benotti M.J., Brownawell B.J. (2007). Distributions of Pharmaceuticals in an Urban Estuary during both Dry- and Wet-Weather Conditions. *Environ. Sci. Technol.*, 41, 5795-5802.
- Welker A. (2007). Occurrence and fate of organic pollutants in combined sewer systems and possible impacts on receiving waters. *Water Sci. Technol.* 56(10):141-8.