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Micropollutants removal efficiency of stormwater control measures: comparison of centralized vs source control systems.

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Abstract: Many studies have analysed and quantified stormwater runoff polluting impact in water bodies. In the meantime municipalities encourage the use of stormwater control measures (SCM) to reduce waterflows and pollutant contamination. In this context, the Micromegas project aims at i) determining how to evaluate the efficiency of SCMs regarding micropollutant (MP) removal and ii) comparing the efficiency of centralized "end of pipes" SCMs versus source control systems. Their efficiency is determined through in-situ sampling, the quantification of 54 MP and the comparison of concentration loads at the outlet of a retention basin (centralized system) and three source control systems (a swale, a trench and a porous pavement) with respectively water from the supplying pipe network and the outlet of a similar impervious asphalted site. This article presents our first results regarding these four sites efficiency as well as the monitoring and sampling procedures and the comparison methodology.

Keywords: Micropollutant; source control; stormwater control measures

It is known since the 80s that stormwater discharges are responsible for heavy metal and hydrocarbon (PAHs) contamination of watercourses. Since the promulgation of the European Water Framework Directive (EWFD 2000), recent studies (e.g. Becouze-Lareure *et al.* 2015, Birch 2012, Gasperi *et al.* 2014) have highlighted the presence of other micropollutants (MP) such as PBDEs, alkylphenols, pesticides, phthalates, PCBs, Bisphenol A suspected to present health and environmental risks.

In the meantime, French municipalities encourage the use of stormwater control measures (SCM) such as basins, swales, trenches, green roofs, porous roads known for reducing water flows and supposed to mitigate pollution impact. Except for heavy metals (Pb, Cu, Zn, Cd) or PAHs (e.g. Strecker *et al.* 2004, Silva *et al.* 2010, Hatt *et al.* 2009), very few literature exists on their real efficiency regarding other MP removal. Some studies addressed the MP loads and concentrations at the outlet of catchments drained by source control SCM (e.g. Bressy *et al.* 2014) or the performance of large centralized basin (Sebastian *et al.* 2015) but none of them addresses the performance of decentralized SCM and the comparison with centralized SCM on a large set of MP

For that purpose, the Micromegas project was launched in 2015. One of its key research action aims to i) establish and implement a new methodology to evaluate the efficiency of SCM regarding MP removal, and ii) compare the performance of different kinds of SCM (centralized/source control). The project is based on *in-situ* monitoring of four sites (**Table 1)**: three decentralized (A vegetated swale, a trench, a porous parking lot) and one centralized (a retention detention basin)**.** MP considered are 14 metals, 16 PAHs, 8 alkylphenols, 9 pesticides and 7 PBDEs, in particular and dissolved phases. These MP have been chosen either because they have been already detected on centralised sites (Sebastian *et al.* 2015) or because they are recognized as harmful and/or dangerous by the EWFD.

For each site and for the same rain events, flow proportional samples are taken at the outlet of the different systems. Their concentrations and loads are compared to those obtained at the outlet of traditional drainage systems (i.e. water from a similar parking lot with an impervious asphalt cover for the source control SCMs or water from the pipe network supplying the retention/ detention basin).

The paper will: (i) present the monitoring system specifically developed (**Figure 1**), (ii) the sampling procedures and uncertainties, (iii) the comparison methodology and bias and (iv) the first results of the treatment efficiency of the different systems and their comparison. The analysis will discuss the role of the speciation of the MP (dissolved and particular phases).

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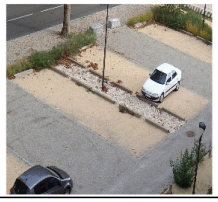
Table 1 Characteristics of the different experimental sites of the Micromegas project.

Type	Centralized	Decentralized (source control)		
Location	D. Reinhardt (DjR) (Chassieu)	EcoCampus La Doua (Villeurbanne)		
System	Retension basin	Swale	Trench filled with gravels 	Porous pavement with reservoir structure
Catchment area	185 ha	290 m² (0.03 ha)	240 m² (0.02 ha)	90 m² (0.01 ha)
Type of catchment	industrial area	parking lots in residential area and university site		

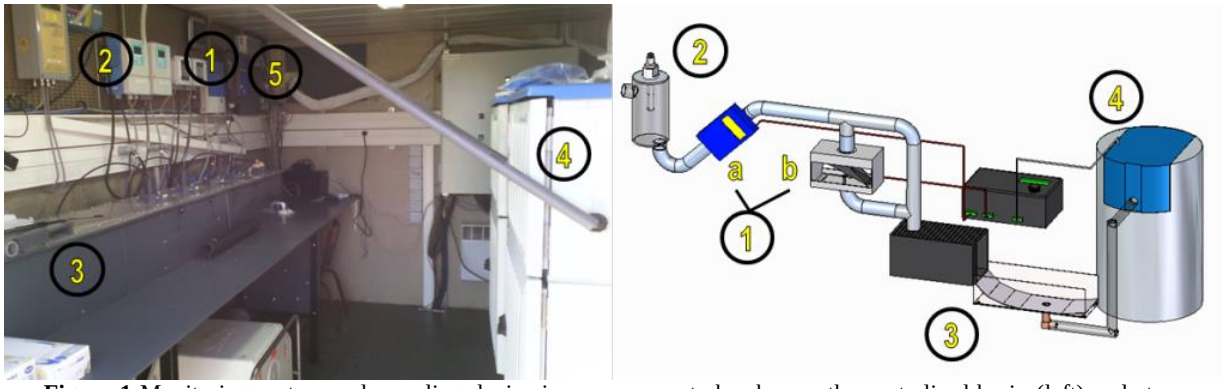


Figure 1 Monitoring system and sampling device in measurement chamber on the centralised basin (left) and at the outlet of the source control systems (right). [1] Flowmeter (a. electromagnetic, b. tipping bucket); [2] Conductivity and Temperature; [3] Sampling gullet prototype; [4] Automatic sampler; [5] pH. (source: Garnier et al., 2017)