- ABSTRACT

Road and parking runoffs represent a complex mixture of micropollutants resulting from traffic, contributing to the deterioration of the aquatic environment. Different filtration treatment devices *in situ* were set up in order to reduce these micropollutants. However, their performances need to be assessed beyond physicochemical measurements, which do not provide informations on toxic effects of mixtures of pollutants. Therefore, samples from three sites, Compans (heavy traffic: two biofilters receiving road runoff: a vegetative strip and a biofiltration swale), Rosny-sous-Bois (moderate traffic, road runoff filtered or not on horizontal sand filters) and Villeneuve-le-Roi (residential area, permeable vegetated parking runoff) were studied. A unique sampling campaign was realized on the STOPPOL compact settling and filtrating device located on a heavily trafficked riverbank road within Paris.

Toxic potential assessment of the road and parking runoffs was performed using an extended variety of prokaryotes and eukaryotes by (1) *in vitro* bioassays on prokaryotic and eukaryotic organisms (luminescent bacteria, microalgae, crustacean, constituting the « Regulatory panel », as well as bacteria, algae, yeast and human cells for the general toxicity, endocrine disruption and cellular stress panels ;(2) *in vivo* bioassays on zebrafish larvae, to measure embryonic and behavioral toxicity (darkness-induced stress).

For the site of Compans, the toxic potential showed a temporal variability of untreated road runoff, related to events features (dry weather, rain intensity, polluting charge etc.) as well as a deterioration of the samples at the device outlets. Results of mortality and malformations of the zebrafish larvae were inconclusive as to the effectiveness of the devices, lacking sensitivity. However, a longer exposure to these samples and on earlier stages of development has consequences that are more important on this organism. The stress test, more sensitive, confirms not only the runoff toxicity, but also a greater toxicity of the samples at the outlet of the biofiltration swale (BFS) and sometimes the vegetative filter strip (VFS). These results strengthen the previous hypothesis based on chemical analysis suggesting of a plausible emission of pollutants from the constituent materials (drains, associated filter fabrics and geomembranes).

For the site of Rosny-sous-Bois, the device does not improve the apparently low toxicity of the inlet and outlet samples, although the chemical analysis shows efficiency to reduce the concentrations of many micropollutants. Indeed, the depolluting effect is unclear, due to the complex pharmacological and toxicological dynamics of some molecules in the samples, as shown by the activity profiles of the larvae during the stress assay.

Concerning the site of Villeneuve-le Roi, the analysis from the bioassays panel shows a discrete quality improvement at the device outlet, linked to the removal of the endocrine disruption effect and the toxicity on yeast, mitigated by the appearance of toxicity on human cells and algal growth. This is in contrast to the analysis made on zebrafish larvae, where behavioral toxicity is observed, at both the inlet and outlet of the device, although differently in each case. According to this test, the device does not appear to improve significantly the runoffs quality. Furthermore, chemical analysis shows its relative inefficiency to reduce some of the micropollutants, even being itself a source of emission.

For the STOPPOL device, the samples were only analyzed by the panel approaches, and revealed a low toxicity, which was equivalent at the inlet and outlet.

Taken together, the results indicate that all the samples have low toxicities and diversity. The devices, while allowing an efficient reduction of particulate pollutants, appear less efficient to decrease the toxic potential of the dissolved phase of runoff, regardless their depolluting type (vegetative filter strip, biofiltration swale (Compans), permeable vegetal parking (Villeneuve-le-Roi) the horizontal planted filter (Rosny-sous-Bois), or the STOPPOL device (Paris). The dissolved phase toxicity assessment is relevant and important, not only for aquatic organisms as it is the main exposure route, but also because of the possible infiltration in the ground water and the potential impact on soil biodiversity. The analysis carried by the both the *in vitro* and whole organism bioassays (Compans, April 2017; Villeneuve-le-Roi, 16/01/2018) lead to similar conclusions, which shows the relevance of the complementarity and the diversity of these approaches. Further studies of other markers, such as endocrine disruption on whole organism, at later stages or the use of alternative organisms could confirm and complete these analyses.

- KEYWORDS: ECOTOXICITY, BIOASSAYS, ZEBRAFISH, STORMWATER, RUNOFF, MICROPOLLUTANTS