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► To cite this version:

Tiago De Oliveira, Maxime Chaillou, Du Phuc Tho Dang, Nadège Caubrière, Martin Guillon, et al.. Tire and road wear particles contamination in infiltration ponds sediments: occurrence, spatial variability, size distribution and correlation with metals. SETAC Europe 34th Annual Meeting, May 2024, Séville, Spain. hal-04533821

HAL Id: hal-04533821

<https://hal.science/hal-04533821>

Submitted on 5 Apr 2024

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Title:

Tire and road wear particles contamination in infiltration ponds sediments: occurrence, spatial variability, size distribution and correlation with metals

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Abstract:

Efficient stormwater management has become a major challenge. Sustainable urban drainage systems (SUDS) such as infiltration ponds have been implemented in sensitive areas, particularly in urban ones. These SUDS play a critical role in regulating water flow but also reducing pollutant load to downstream environment through decantation, soil filtration, photooxidation and biodegradation. In fact, runoff collected from road surfaces contains several categories of pollutants, including heavy metals, organic micropollutants, and microplastics such as tire and road wear particles (TRWP).

To improve our knowledge on the TRWP levels in runoff discharges and the capacity of SUDS to reduce TRWP load, we investigated the occurrence, spatial distribution and size distribution of TRWP in the sediment of an infiltration pond of the ring road in Nantes city (France). The sediment was fractionated between $<36\text{ }\mu\text{m}$ and $500\text{ }\mu\text{m}$, and analyzed by pyrolysis coupled with gas chromatography-mass spectrometry. Analyzes targeted two polymeric content of tires, namely, styrene-butadiene-rubber (SBR) and butadiene-rubber (BR), with the use of an internal deuterated SBR standard for calibration.

Measurements highlighted an SBR+BR gradient in the infiltration pond with contents ranging from $1.28 \pm 0.05\text{ mg/g}$ to $7.15 \pm 0.29\text{ mg/g}$. Three distinct sections were delineated: entrance, middle and overflow. The sediment closest to the overflow was the most enriched in SBR+BR, consistent with the water runoff in the basin and the topography. Upon a closer examination of the size fractionation of SBR+BR content within the sediment from entrance, middle and overflow, the $63\text{-}160\text{ }\mu\text{m}$ fraction prevails. Furthermore, positive correlations

between SBR+BR levels and particulate organic matter (POM) or metals (As, B, Cd, Cu, Li, Mo, Ni, Zn) ($r > 0.76$, $p < 0.05$) were observed. This suggests that TRWP may act as vector for metallic pollution and a carrier for POM, or behave in a similar way. Using a median SBR+BR-to-TRWP conversion factor of 13.2, the TRWP stock in the pond was determined and compared to the estimated cumulative TRWP input from road traffic. The calculation revealed similar amounts (of the order of 1.0 to 1.1 tons), suggesting that infiltration ponds can be an effective solution to limit the dispersion of TRWP into the environment.