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To cite this version:
Mathieu Cladière, Lauriane Vilmin, Céline Bonhomme, Johnny Gasperi, Nicolas Flipo, et al.. Determinition of in-situ biodegradation rate constants of nonylphenolic compounds in the Seine River. 14th EuCheMS International Conference on Chemistry and the Environment, Jun 2013, Barcelone, Spain. 2013. <hal-00862202>

HAL Id: hal-00862202
https://hal-enpc.archives-ouvertes.fr/hal-00862202
Submitted on 16 Sep 2013

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Determination of in-situ biodegradation rate constants of nonylphenolic compounds in the Seine River

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1- INTRODUCTION

Assessing the fate of endocrine disrupting compounds (EDC) in the environment is currently a key issue for determining their impacts on aquatic ecosystems. The 4-nonylphenol (4-NP) is a well known EDC as well as its precursors, the nonylphenol monoethoxylate (NP,EO) and the nonylphenol acetic acid (NP,EC), they result from the biodegradation of surfactant nonylphenol ethoxylates (NPnEO). To date, the biodegradation rate constants of nonylphenolic compounds have been mostly studied in laboratory and only Jonkers et al. (2005) focus on in-situ rate constants but in estuarine salt water. Therefore data on in-situ biodegradation of nonylphenolic compounds in river water are scarce or not up to date.

This study aims at evaluating the in-situ biodegradation of 4-NP, NP,EC and NP,EO in the Seine River downstream of Paris City.

2- METHODOLOGY

- 40 km long transect downstream of Paris city
- 2 sampling campaigns: July and September 2011
- Hours of sampling estimated according to velocity of the Seine River
- Samples collected in the same volume of water
- Analysis: UPLC-MS-MS → quantification of 4-NP, NP,EC and NP,EO
- Results → calibrating a sub-model of NPnEO biodegradation of ProSe model
- The spatial and temporal variabilities of concentrations are considered for calibration
- Calibration of $K_i = K_i'$, $K_2$ and $K_3$ based on first order kinetics equations
- Calibration of “precursor inputs” to symbolize biodegradation of NPnEO and NPnEC

3- RESULTS

2- RESULTS

- Campaign carried out during an algal bloom. This algal bloom likely induces an increase of heterotrophic bacterial biomass (Kisand and Noges, 1998)
- Biodegradation rate constants are far higher than those reported by Jonkers et al., (2005) or by Staples et al., (2001).
- No disruption of biodegradative conditions of the Seine River during this campaign. The heterotrophic bacterial biomass is supposed to be representative of conventional conditions of the Seine River

3- DISCUSSION / CONCLUSION

The variability of bacterial biomass likely induces the variance of biodegradation rate constants of nonylphenolic compounds.

The first-order kinetic approach seems reliable to describe a punctual state of biodegradation but does not take into account the variabilities generated by the fluctuation of bacterial biomass.