

國立臺灣海洋大學
海洋環境與生態研究所 專題討論

題目：城市河流中全氟和多氟烷基物質（PFASs）的時空動態及其向周邊生物膜的轉移：以塞納河為例

英文題目：Spatio-temporal dynamics of per and polyfluoroalkyl substances (PFASs) and transfer to periphytic biofilm in an urban river: case-study on the River Seine

作者：Gabriel Munoz, Lise C. Fechner, Emmanuel Geneste, Patrick Pardon, H  l  ne Budzinski & Pierre Labadie

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Abstract

This study addresses the spatio-temporal dynamics of per and polyfluoroalkyl substances (PFASs) in a highly urbanized freshwater hydrosystem, the Seine River (NW France). The distribution of PFASs between water, sediment, and periphytic biofilm was investigated at three sampling sites along a longitudinal gradient upstream and downstream from the Paris urban area. Seasonal variability was assessed through four sampling campaigns performed under contrasting hydrological conditions. In the dissolved phase, \sum PFASs fluctuated between 2 and 9 ng L⁻¹ upstream and 6–105 ng L⁻¹ downstream from Paris. Negative correlations between dissolved PFAS levels and river flow rate were generally observed, corroborating the predominance of point-source PFAS inputs at these sites. 18/19 target PFASs were detected, with a predominance of PFHxS and PFOS (20% of \sum PFASs each), except for the farthest downstream site where 6:2 FTSA was prevalent (35 ± 8% of \sum PFASs), likely reflecting industrial and urban inputs. In biofilms, \sum PFASs fell in the 4–32 ng g⁻¹ dw range, and substantial bioconcentration factors (BCFs) were reported for PFNA, PFDA, and PFOS (log BCF 2.1–4.3), higher than those of PFHxS or PFOA. BCFs varied inversely with dissolved PFAS levels, potentially pointing to concentration-dependent bioaccumulation. Biofilm community characteristics (C/N ratio) may also be an influential determinant of PFAS bioaccumulation.

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中文摘要

該研究探討法國西北部高度城市化淡水系統(塞納河)中全氟和多氟烷基物質(PFASs)的時空動態分佈。沿著巴黎市區上游和下游共三個採樣點以調查水中、沉積物和附生生物膜之間的 PFASs 分佈，並透過對比四次採樣期間之水文條件來評估季節性變化。結果顯示在巴黎上游和下游溶解相 Σ PFAS 濃度分別在 2 至 9 ng L⁻¹和下游 6-105 ng L⁻¹之間波動。溶解相的 PFAS 濃度與河流流速之間觀察到負相關，佐證其採樣點之 PFAS 主要係為點源的輸入。而 19 種目標 PFASs 中共有 18 種被檢出，主要是 PFHxS 和 PFOS (各占 20%的 Σ PFASs)。除了最遠的下游站點係以 6:2FTSA (35±8%的 Σ PFASs) 普遍存在，這可能反映了該點為工業和城市來源輸入。在生物膜中 Σ PFASs 濃度落在 4-32 ng g⁻¹ 範圍內，PFNA、PFDA 和 PFOS 的生物富集係數(BCFs, log BCF 2.1-4.3) 高於 PFHxS 與 PFOA，且 BCFs 與溶解相之 PFAS 濃度成反比，可能指向濃度依賴性生物蓄積之特性。生物膜群落特徵 (C/N 比) 也可能是影響 PFAS 生物蓄積的一個決定因素。