Perfluoroalkyl acids (PFAAs) in the tailwater of the waste water treatment plants (WWTPs) around a shallow lake: distribution, removal, and fluxes

Ying Lu, Kejian Chu, Yuanyuan Liu

Hohai University

Nanjing, China

China is one of the largest consumers of perfluoroalkyl acids (PFAAs). In the production and application of PFAAs, these PFAAs inevitably enter the water environment. They are continuously enriched in organisms, which ultimately affects the safety of the water ecological environment. Luoma Lake is one of the essential storage shallow lakes in the South-to-North Water Diversion Project, and PFAAs have been detected in large quantities in the entire lake. Wastewater treatment plants (WWTPs) are the primary source of PFAAs. It is necessary to conduct an on-site investigation on the contamination levels of PFAAs in the tailwater of the WWTPs around Luoma Lake to develop a targeted and beneficial in situ remediation strategy for PFAAs. In this study, 14 WWTPs around Luoma Lake were taken as the research objects to analyze the concentration distribution of 14 PFAAs in the tailwater of the WWTPs. The results showed that the concentrations of ∑PFAAs in the tailwater of WWTPs were 185.77-423.95 ng/L. Perfluorobutanesulfonate (PFBS), perfluorotridecanoic (PFTrDA), perfluorooctanoic (PFOA), perfluoropentanoic (PFPeA), and perfluorobutanoic (PFBA) were the main PFAAs in the tailwater of WWTPs, accounting for 14.58%, 13.79%, 13.33%, 12.62%, and 11.85% of the total PFAAs, respectively. Further, a positive matrix factorization (PMFA) model was used to explore the primary sources of PFAA, which indicated that industrial wastewater was the primary source of PFAAs. In terms of treatment efficiency, the capacities of WWTPs to treat PFAAs in domestic sewage were higher than that of industrial wastewater, and the efficiency of the activated sludge process to treat PFAAs was higher than that of physical treatment. Finally, based on the annual discharge of the WWTPs, the annual emission flux of PFAA in the tailwater of the sewage treatment plant around Luoma Lake was estimated to be 11224.65±1088.66 g/yr. This study provides essential information for PFAAs in the tailwater of WWTPs and is significant for developing effective control strategies for PFAAs in WWTPs.