

Survey on Perfluorinated Compounds and their Formation Potentials in Water Environment and Feasibility Study on NF/RO Membrane Filtration on their Removal

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1. Background and Objectives

Precursors of perfluorinated compounds (PFCs) can be degraded to PFCs by biological decomposition and/or photodegradation and contribute to the contamination of PFCs in the water environment. However, occurrences of the precursors in the environment have rarely reported and their behavior of PFCs formation is not well known. In this study, surveys were conducted to investigate occurrences of PFCs, their precursors and “PFCs formation potentials” (PFCs-FPs). Here, PFCs-FPs is defined as amount of PFCs which are formed from precursors. In addition, effectiveness of PFCs removal by NF/RO membrane filtration was tested to remove PFCs from tap water created by actual water purification plant (WPP).

2. Materials and Methods

Surveys on the Lake Biwa - Yodo River Basin were conducted in August to October in 2014 and lake water ($n=9$), river water ($n=31$), wastewater ($n=14$) were collected. Surveys on Bangkok metropolitan region in Thailand were conducted in October to November in 2014 and industrial wastewater and tap water ($n=37$) were collected. Samples were pretreated by solid phase extraction method and 12 PFCs and 14 precursors were analyzed. In addition, samples were processed to oxidation and pretreatment to analyze 12 PFCs-FPs. Secondly, tap water was collected from water supplying tank of A WPP and used for experiments to study on the effectiveness of two types of NF membrane and one type of RO membrane for PFCs removal.

3. Results and Discussion

Mass flows of PFOA and PFOA formation potentials in the Lake Biwa - Yodo River Basin are shown in **Figure 1**. At the point of discharge from Lake Biwa, mass flow of PFOA-FP was 131g/day which is 7.3 times larger than PFOA (18 g/day). In addition, mass flow of PFOA-FP was 137 g/day at the confluence point of Katsura River, Uji River and Kizu River into Yodo River, while only 51 g/day from Katsura River and 3 g/day from small tributaries were discharged at upstream. This indicated that PFOA-FP was possibly discharged not only from upstream but also from air, rain and so on.

High concentrations of PFCs-FPs were found in the industrial wastewater in Thailand. $\Sigma 12$ PFCs-FPs concentration were 9,476 ng/L (max.) which is 36 times higher than $\Sigma 12$ PFCs themselves. In this survey, precursors were quantified only 15% of attempted analyses (83/546 data) while PFCs-FPs were quantified 89% of attempted analyses (279/312 data). This indicated that introducing PFCs-FPs and conducting those analyses increase data of precursor's occurrences

As a result of membrane filtration experiments to study on the effectiveness of two types of NF membrane and one type of RO membrane for removal of PFCs from tap water created at A WPP, an NF membrane (NaCl rejection rate 50%) showed more than 85% rejection of PFHxA, PFOA, PFNA and PFOS as well as permeating cations at some extent during 72 hours operation time.

4. Conclusion

Mass flow of PFOA-FP was 137g/day at Yodo River, suggesting that PFOA-FP was not only discharged from upstream but also possibly deposited from air and rain. In addition, effectiveness of NF membrane for removal of PFCs in actual tap water was indicated.

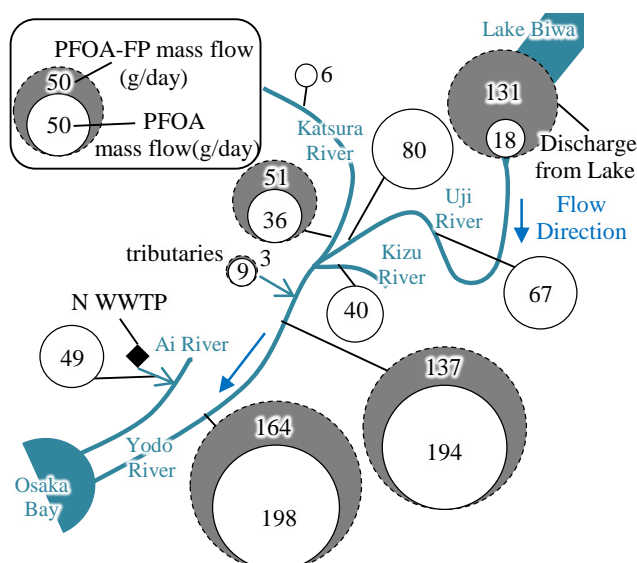


Figure 1 Mass flows of PFOA and PFOA formation potentials in the Lake Biwa - Yodo River Basin