Polyfluorinated organic compounds in the dutch fresh water environment

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Introduction

Perfluorinated compounds (PFCs) are persistent surfactants that have been produced for several decades. They have been detected in several human and environmental monitoring studies all over the globe [1]. To date, most research addressed analytical chemistry of PFCs while studies on the in situ distribution over major compartments in water systems are relatively scarce. Here we report the occurrence and distribution of PFCs in water, sediment and eel at several fresh water locations in the Netherlands in 2007. Results are compared to levels in upstream emission sources.

Figure 1.
Sampling locations.

Experimental

Samples

- Water (n=20), sediment(n=19) and eel samples(n=21) taken from 21 locations that cover major rivers, lakes and canals in the Netherlands (fig 1).
- Sediment samples were sieved and fractions <63µm were freeze-dried.
- Each eel sample consist of up to 25 eels with a length of 30-40 cm.

Target compounds

- Perfluoroalkyl carboxylates (PFBA, PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDcA, PFUnA, PFDoA, PFTrA, PFTeA) and Perfluoroalkyl sulfonates (PFBS, PFHxS, PFOS).

Extraction and clean-up

- 5 g sediment, 6 g eel, 1 L water
- Internal standards, $^{13}C_4$-PFOA (40 ng) and $^{13}C_4$-PFOS (40 ng)
- Extraction of water samples with Oasis HLB SPE column (20cc 1g), extraction of sediment and eel samples by ultrasonic extraction with acetonitril.
- Clean-up by partitioning with hexane followed by clean-up on ENVIcarb.

Quantification

- Analysis performed by HPLC/ESI(-)-MS/MS

Quality Assurance /Quality Control

- Recovery testing with spiked sample (recovery 71-96% for all PFCs except for PFPA, PFHpA, PFTrA and PFTeA which were not tested).
- Method detection limits ranged from 0.3 - 3 ng/L in water samples and 0.06 - 0.6 ng/g for sediment and eel samples.
- Method blanks were clean with no PFCs detected.

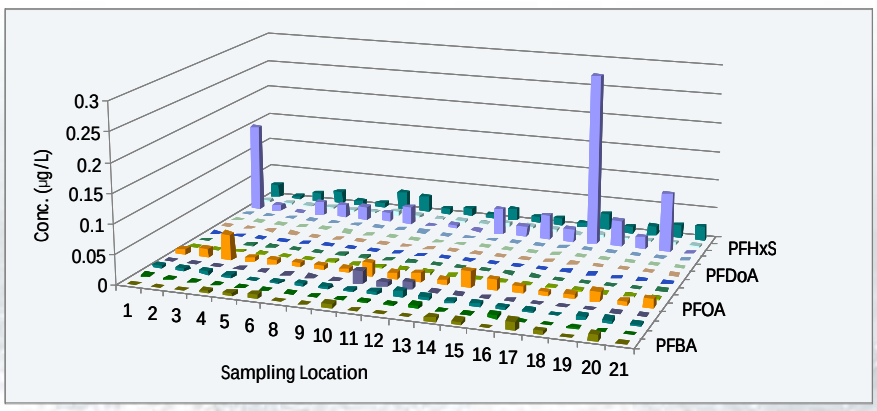


Figure 2. Concentrations in water samples.

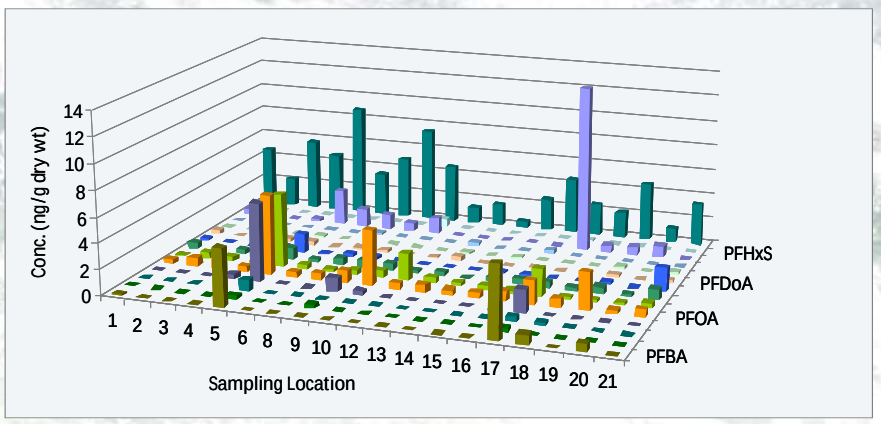


Figure 3. Concentrations in sediment samples.

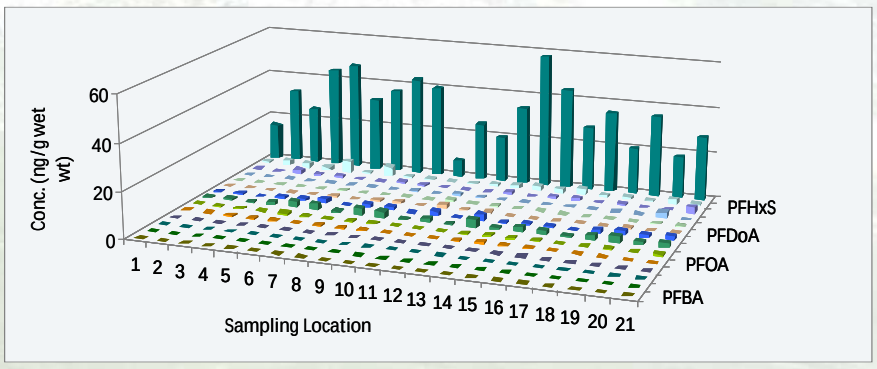
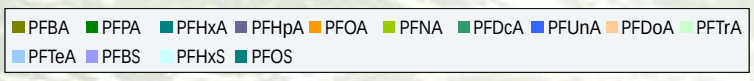


Figure 4. Concentrations in eel samples.



Results and Discussion

- PFC concentrations in water (fig 2) were similar to those found in upstream PFC sources, i.e.PFOS concentrations between LOD and 26 ng/L and PFBS between LOD and 46 ng/L, in some parts of the Rhine in Germany [2].
- PFOS was the only PFC detected in all samples and the dominant PFC in eel and sediment samples (fig 2, 3 and 4).
- In 13 out of 20 water samples, PFBS, which is relatively hydrophilic, was the dominant PFC (fig 2).
- Only perfluoroalkyl carboxylates(PFCAs) with >6 fluorinated carbons were detected in eel (fig 4). This suggests increased bioaccumulation with increasing chain length, which agrees to findings in other studies (eg. PFCAs with 4-6 fluorinated carbons are not or infrequently detected in wildlife,[3]).

References

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3. Conder, J.M., et al., Are PFCAs bioaccumulative? A critical review and comparison with regulatory lipophilic compounds. Environmental Science & Technology, 2008. 42(4): p. 995-1003.

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Wageningen UR and TNO have joined forces by housing their applied marine research in a newly established institute, IMARES.

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