

Which PFAS should we be looking for in the environment and how does this relate to the new EU drinking water directive?

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Thanks to my Norwegian and Swedish colleagues [Ida Johansen](#) and [Katrin Holmström](#)

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EU drinking water directive - 2020/2184

Implementation

Directive includes drinking water criteria for PFAS

Timeline

- 12-01-2023 Implemented in legislation for EU member states
- 12-01-2026 Measures in place to ensure compliance with criteria in Part B

PFAS

- 12-01-2024 Technical guideline for analysis:
 - PFAS total
 - sum of specific PFAS

EU drinking water directive - 2020/2184

Criteria for PFAS

- 0,1 µg/l for sum of 20 PFAS (100 ng/l)

No problem
- but are the 20
PFAS sufficient?

- 0,5 µg/l for "total PFAS" (500 ng/l)

requires agreement on
an analytical method
by 2024

- EU directive is a minimum directive - more stringent criteria or additional parameters can be included in the national regulations

Are 20 PFAS in the EU drinking water directive sufficient?

Persistent and dead-end degradation compounds

Carboxylic acids		Sulfonic acids	
PFBA	$C_3F_7 \bullet COOH$		
PFPeA	$C_4F_9 \bullet COOH$	PFBS	$C_4F_9 \bullet SO_3H$
PFHxA	$C_5F_{11} \bullet COOH$	<i>PFPeS</i> #	$C_5F_{11} \bullet SO_3H$
PFHpA	$C_6F_{13} \bullet COOH$	<i>PFHxS</i> *	$C_6F_{13} \bullet SO_3H$
<i>PFOA</i> *	$C_7F_{15} \bullet COOH$	<i>PFHpS</i> #	$C_7F_{15} \bullet SO_3H$
<i>PFNA</i> *	$C_8F_{17} \bullet COOH$	<i>PFOS</i> *	$C_8F_{17} \bullet SO_3H$
PFDA	$C_9F_{19} \bullet COOH$	<i>PFNS</i> #	$C_9F_{19} \bullet SO_3H$
<i>PFUnDA</i> #	$C_{10}F_{21} \bullet COOH$	<i>PFDS</i> #	$C_{10}F_{21} \bullet SO_3H$
<i>PFDoDA</i> #	$C_{11}F_{23} \bullet COOH$	<i>PFUnDS</i> #	$C_{11}F_{23} \bullet SO_3H$
<i>PFTTrDA</i> #	$C_{12}F_{25} \bullet COOH$	<i>PFDoDS</i> #	$C_{12}F_{25} \bullet SO_3H$
		<i>PFTTrDS</i> #	$C_{13}F_{27} \bullet SO_3H$

* new proposal EFSA:TWI (Tolerable weekly intake) 4.4 ng/kg bw per week for sum of 4 PFAS

PFAS not included in present sum criteria in Denmark og Sweden

PFAS investigations (source identification)

We only find what we look for in groundwater or surface water

Analytical packages with up to 32 - 49 PFAS are available at commercial laboratories

All PFAS in the **drinking water directive**

(maybe distinguish between branched and linear PFOS and PFHxS)

+ **precursors** (PFAS which can degrade to persistent PFAS (dead end compounds))

Fluorotelomers: 4:2 FTS, 6:2 FTS, 8:2 FTS (degrades → PFOS)

Perfluorosulfonamides....

+ **new PFAS** Gen-X, ADONA, F-53B

“Total” Oxidizable Precursors (TOP): Mass balance with known and unknown precursors (Analysis before and after oxidation)

AOF/EOF:

Adsorbable/Extractable organic fluorine (=TOF, Total organic fluorine?)

No indication about source

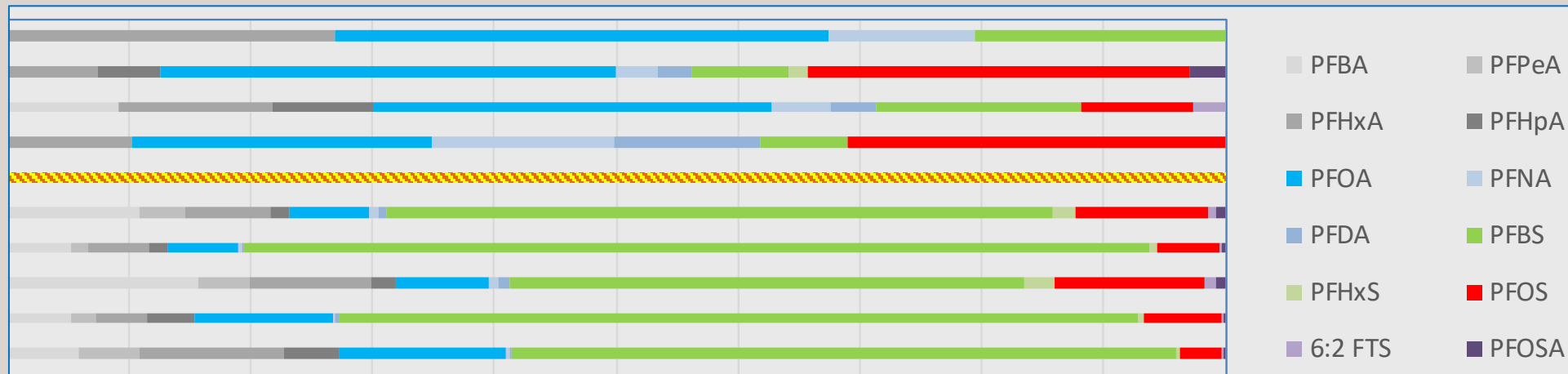
| Total PFAS | | Specific PFAS |

PFAS investigations (source identification)

We only find what we look for in groundwater or surface water

Decisions: Detailed analytical packages allow comparison of PFAS-composition in water samples from different sources (fingerprint) and possibly identification of PFAS source.

The newer PFAS formulations might produce different patterns also after TOP.



Are 20 PFAS in the EU drinking water directive sufficient?

Minimum regulatory requirement satisfied – but what are the consequences?

Two situations:



1. $\Sigma 20$ PFAS **<100 ng/l**
No risk?
What about other PFAS?
Criteria for PFOS and PFOA much lower (see following slides)
2. $\Sigma 20$ PFAS **>100 ng/l**
Problem for water supply
Need to identify source (Fingerprint)

Conclusion: National legislation or good practice will include additional PFAS
National criteria will also include stringent (lower) criteria for specific PFAS

Health risks – The more we know...

The downward path

- Drinking water criteria are usually derived based on TWI (Tolerable weekly intake) from all sources food, water, air
- Allocation to drinking water often 10%

DK
100 ng PFOS/l
= 100 ng Σ 12
PFAS/l

DK
6 ng PFOS/l
3 ng PFOA/l

	PFOS	PFOA	PFNA	PFHxS
	TWI ng/kg body weight per week			
2008	1.050	10.050		
2018	13	6		
2020*	4.4			

?? 2 ng/l for
sum of 4

*new proposal EFSA:TWI (Tolerable weekly intake) 4.4 ng/kg bw per week for sum of 4 PFAS

EU Environmental Quality Standards – PFOS

PFOS-EQS dossier - EU Directive 2013/39/EU – implemented DK 1625- 19-12-2017

EQS for PFOS as an annual average in surface waters

0.65 ng/l Freshwater

0.13 ng/l Marine water

These low values are implemented in Danish legislation

In PFOS dossier, specific quality standards with respect to the protection of aquatic life are:

230 ng/l Freshwater

23 ng/l Marine water

EU Environmental Quality Standards – PFOS

PFOS-EQS dossier - EU Directive 2013/39/EU – implemented DK 1625- 19-12-2017

EFSA
2008

Tolerable human consumption

TWI = 1050 ng/kg bw/week (TDI = 150 ng/kg bw/day) = 10500 ng/day for an adult of 70 kg

10% allocated to contribution from fish and consumption of up to 115 g fish/day*

Maximum content in fish = 9130 ng/kg (10500*0.1/0.115)

Conversion to water concentration

Bioconcentration factor (BCF) = 2796, Biomagnification factor (BMF1) = 5

Annual average in freshwater = $9130 / (2796 * 5) = 0.65 \text{ ng/l}$

For marine water, an additional BMF2 of 5

Annual average in marine waters = $9103 / (2796 * 5 * 5) = 0.13 \text{ ng/l}$

Danish drinking water: criterium for PFOS (assumes 2 litres/day) = 6 ng/l

EFSA
2018

Conclusions

- National drinking water legislation or good practice will probably include additional PFAS other than the 20 EU-PFAS
- National criteria will probably include stringent (lower) criteria for specific PFAS
- Experience and new analytical possibilities will give new insights in PFAS contamination from different sources
- New toxicological evaluations based on human blood levels and food sources might lead to new low criteria for drinking water and surface water
- Characterisation and identification of PFAS-sources require extensive analytical tools



Thank you for your attention