PMT/vPvM-substances in drinking water resources – why there is momentum for a proactive approach

Dr Claudia Castell-Exner – EurEau President

3rd PMT-Workshop – 25/26 March 2021

Who we are ...

EurEau

~ EurEau is the **European Federation of Water Services** (*founded 1975*)

~ 34 national associations of **drinking and waste water operators** from 29 European countries

~ Providing essential services

~ Realising the human right to water and sanitation

~ Protecting public health and the environment

70,000 operators
(average size: 8 employees)

UN Right to Water

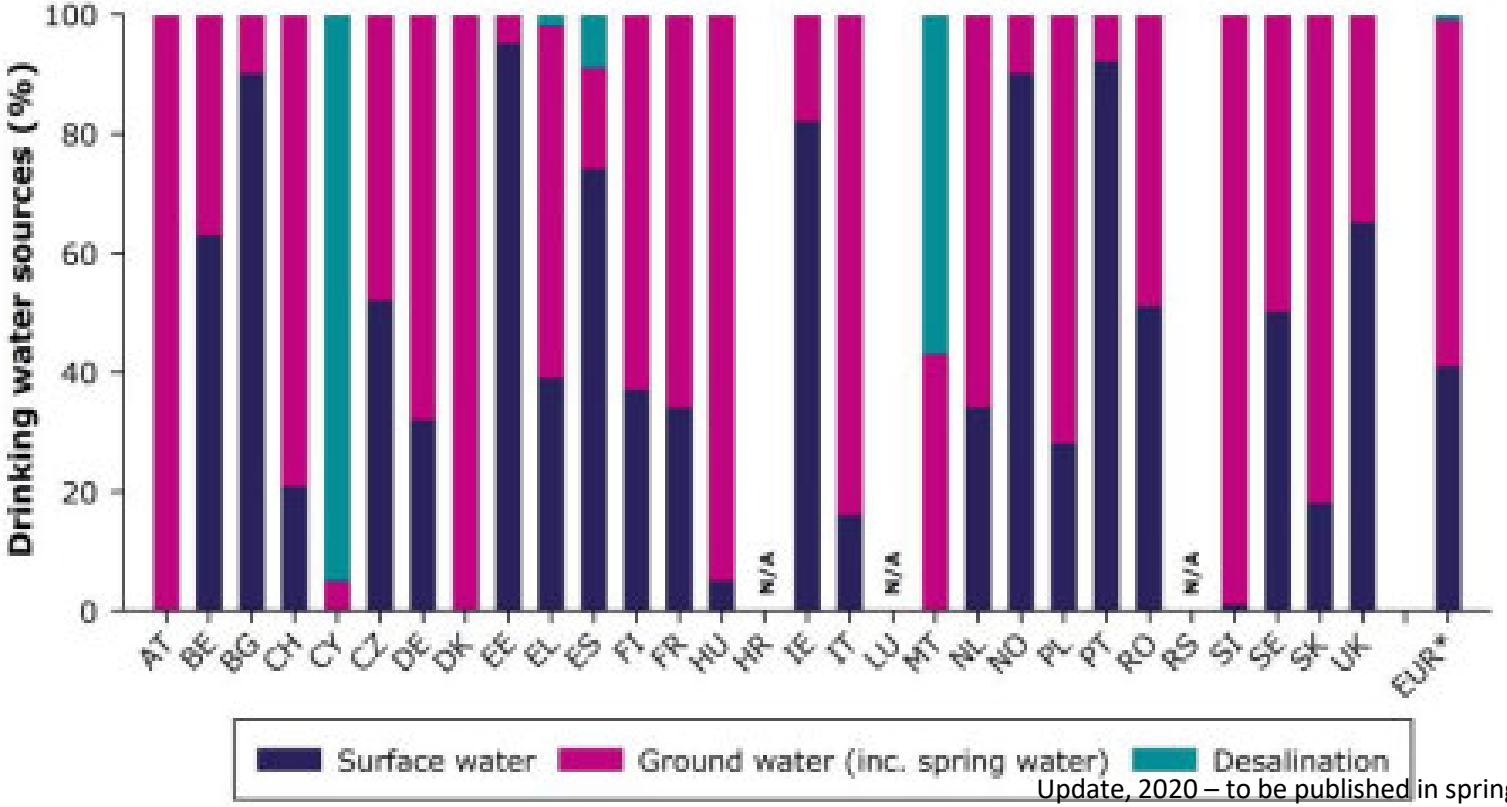
- Affordability
- Accessibility
- Availability
- Acceptability
- Safety

Europe's water in figures

An overview of the European drinking water and waste water sectors

2017 edition

EurEau



Update, 2020 – to be published in spring 2021

Drinking water quality - requirements

- wholesome and clean
- colourless, clear and cool
- free of suspended solids
- free of disease-causing organisms and toxic chemicals
- perfect in taste and smell
- non-corrosive
- appetising and inviting to drink

Drinking water treatment in Europe

EurEau

Practical Paper

Drinking water treatment technologies in Europe: state of the art – challenges – research needs

J. P. van der Hoek, C. Bertelkamp, A. R. D. Verliefde and N. Singhal

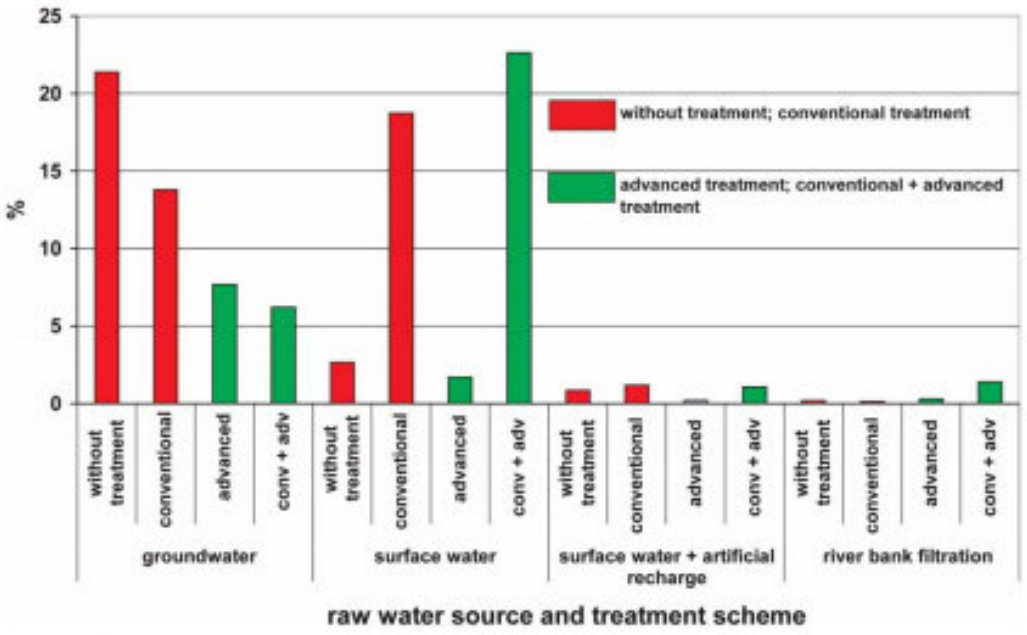


Figure 2 | Raw water sources and treatment schemes.

Conventional:
Aeration; rapid sand filtration; coagulation – sedimentation – filtration; artificial recharge

- Groundwater:
  - 71% not treated or with a conventional system (*35% of total drinking water production*)
- Surface water:
  - 47% is not treated or with only a conventional system (*22% of total drinking water production)*

Taking also surface water with artificial recharge and river bank filtration into account,
in total 59% of the drinking water produced in Europe is not treated or only treated with conventional treatment schemes.

Drinking water quality – new Directive published

EurEau

23.12.2020 EN Official Journal of the European Union L 435/1

I

(Legislative acts)

DIRECTIVES

DIRECTIVE (EU) 2020/2184 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 16 December 2020

on the quality of water intended for human consumption

(recast)

The new Drinking water Directive – a long way

2014 **Public consultation**

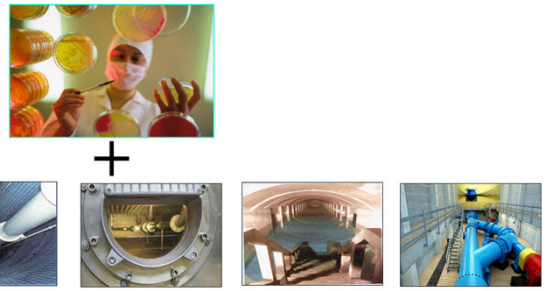
2015 Start **Evaluation** „old“ Directive

Small revision / Implementation of **risk assessment and risk management**

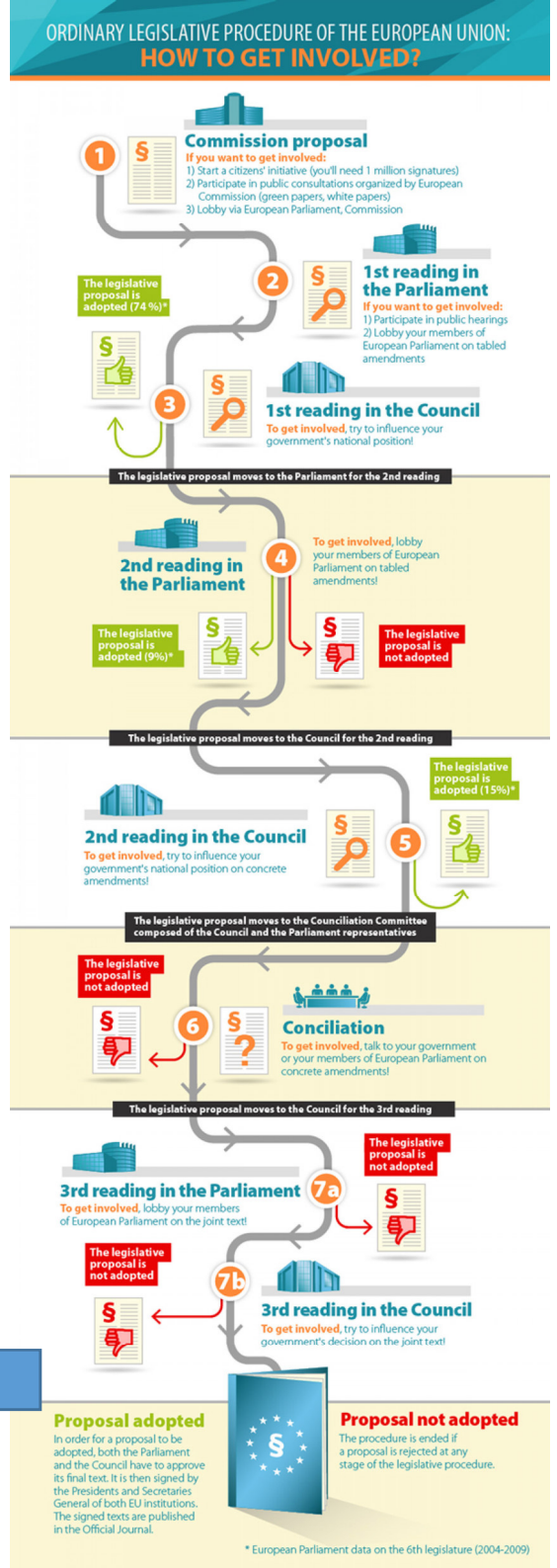
2016 World Health Organization **Policy options, WHO-recommen-dations**

2017 **Impact Assessment**

2018 EU-Commisson launches **draft proposal** for new DWD



2020

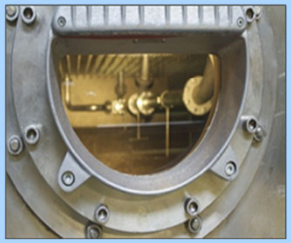


Drinking water quality – future requirements

World Health Organization

Risk assessment and management from catch2tap






All stakeholders to be involved in preventive and mitigation measures to protect drinking water resources

Drinking water quality – PFAS

PFAS Total	0,50	µg/l	'PFAS Total' means the totality of per- and polyfluoroalkyl substances. This parametric value shall only apply once technical guidelines for monitoring this parameter are developed in accordance with Article 13(7). Member States may then decide to use either one or both of the parameters 'PFAS Total' or 'Sum of PFAS'.
Sum of PFAS	0,10	µg/l	'Sum of PFAS' means the sum of per- and polyfluoroalkyl substances considered a concern as regards water intended for human consumption listed in point 3 of Part B of Annex III. This is a subset of 'PFAS Total' substances that contain a perfluoroalkyl moiety with three or more carbons (i.e. –CnF2n–, n ≥ 3) or a perfluoroalkylether moiety with two or more carbons (i.e. –CnF2nOCmF2m–, n and m ≥ 1).

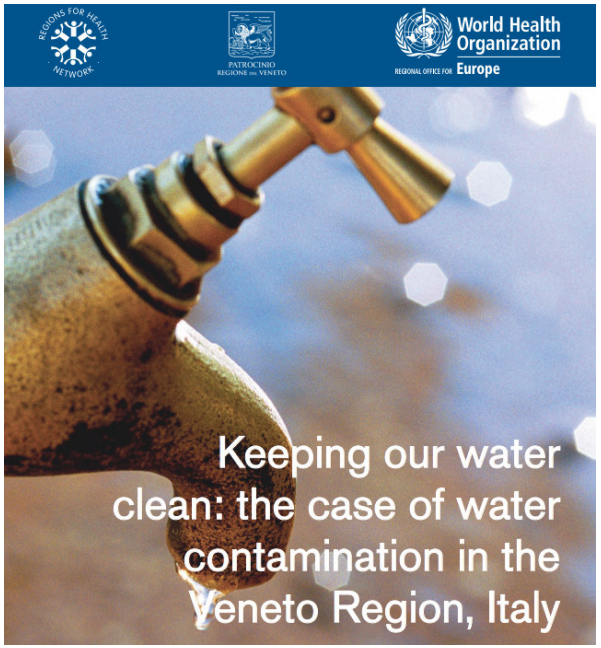
The following substances shall be analysed based on the technical guidelines developed in accordance with Article 13(7):

Those substances shall be monitored

- when the **risk assessment and risk management of the catchment areas** for abstraction points carried out in accordance with Article 8
- **conclude that those substances are likely to be present in a given water supply.**

Sum of PFAS	
Perfluorobutanoic acid (PFBA)	Perfluorobutane sulfonic acid (PFBS)
Perfluoropentanoic acid (PFPA)	Perfluoropentane sulfonic acid (PFPS)
Perfluorohexanoic acid (PFHxA)	Perfluorohexane sulfonic acid (PFHxS)
Perfluoroheptanoic acid (PFHpA)	Perfluoroheptane sulfonic acid (PFHpS)
Perfluorooctanoic acid (PFOA)	Perfluorooctane sulfonic acid (PFOS)
Perfluorononanoic acid (PFNA)	Perfluorononane sulfonic acid (PFNS)
Perfluorodecanoic acid (PFDA)	Perfluorodecane sulfonic acid (PFDS)
Perfluoroundecanoic acid (PFUnDA)	Perfluoroundecane sulfonic acid
Perfluorododecanoic acid (PFDoDA)	Perfluorododecane sulfonic acid
Perfluorotridecanoic acid (PFTrDA)	Perfluorotridecane sulfonic acid

Cases



Belgium:

- *PMT-substances (1,4-dioxane, diisopropylether, EDTA, NTA, pyrazole, TFA, benzotriazole, methenamine, urotropine, MTBE, atrazine) have been found in surface water at the µg/L range, even above 10 µg/L in rivers such as Meuse and Rhine.*
- *PMT are less present in groundwater although tests found local pollution with for example carbon tetrachloride, chloroform and many other chlorinated solvents.*
- *By extrapolation, we can expect to find many others not intensively monitored today*

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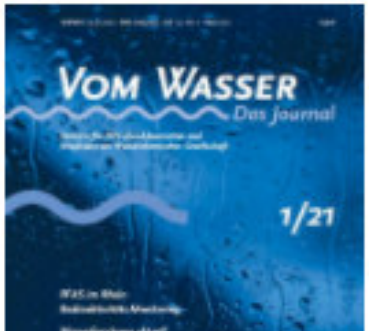

Fachbeiträge

L. Lesmeister, M. Scheurer, F. Th. Lange, C. K. Schmidt

Belastungssituation des Rheins mit Per- und Polyfluoralkylsubstanzen (PFAS)

Chemours

In 2012, the DuPont/Chemours chemical plant converted its production to GenX technology and phased out PFOA because of associated hazard concerns. The change involves the discharge by the plant of the FRD-903 compound into the water. Since 2013, the plant has had a license to di
wastewater treatment system; in April 2017, the pe
reduced. The measurement results now analysed
by far the most important source of the FRD-903 p
shows that the presence of GenX is not widespread
Netherlands.

Germany (GWDB BW):

- *In 3.0 % of the analysed groundwater measuring points, the sum of PFAS was above the new EC limit value of 0.1 µg/L (56 measuring points contaminated out of a total of 1841 analysed measuring points).*

Drinking water treatment

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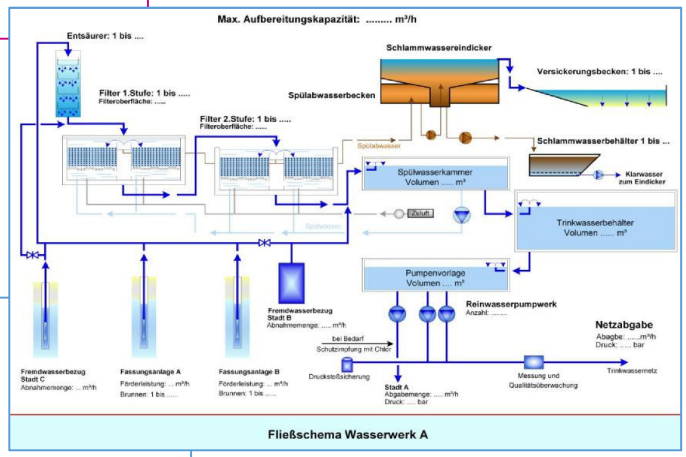
BASICS:

- **Mobility ≠ Hydrophobic interactions**
- **Persistence ≠ Biodegradation**

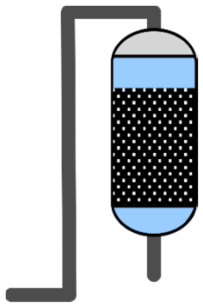


Fließschema Wasserwerk A

Treatment steps have limits:

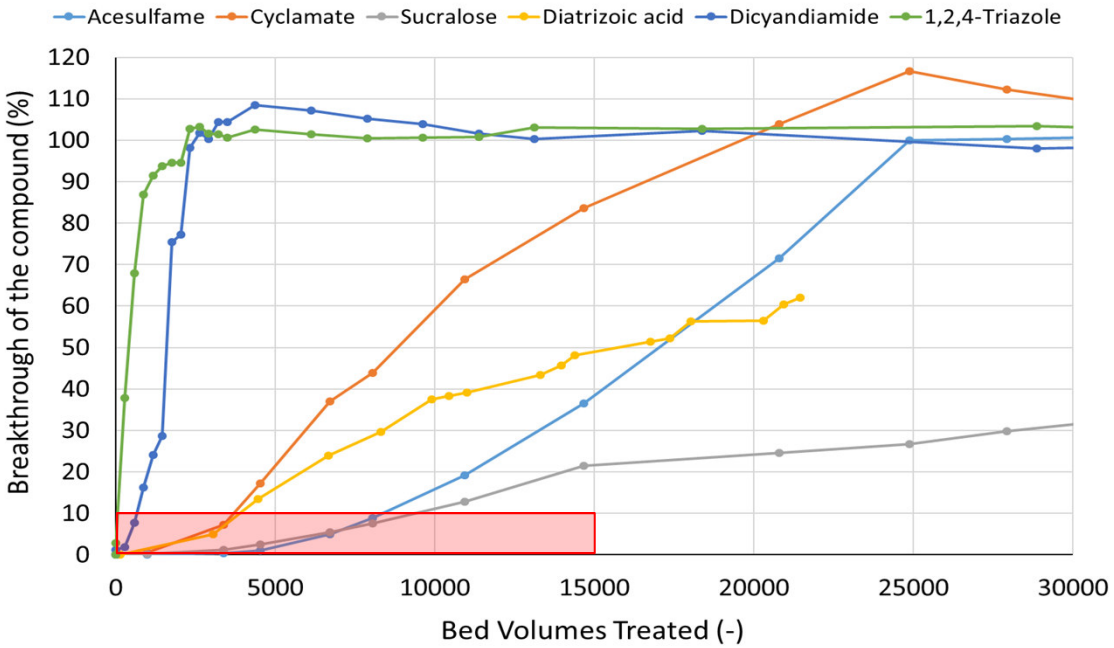
- they cannot eliminate 100 % of an impurity
- they do not selectively remove just one undesirable impurity
- their effectiveness does not remain constant over time
- they can produce tranformation products
- they move the problem to the concentrate that has to be disposed
- they counteract the wish for the natural character of drinking water
- energy intensive (contradicts EU Green Deal objectives)

Removal of PMT/vPvM-substances in drinking water treatment



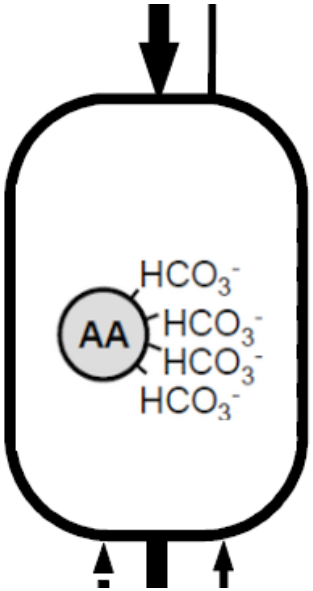
Activated carbon-filtration

- fast saturation (4-8 months) for short chain PFAS like PFBA but better performance for longer chains like PFOA
- Prefiltration required
- No indication of saturation/exhaustion => analyses required
- vPvM substances ⟶ low elimination potential



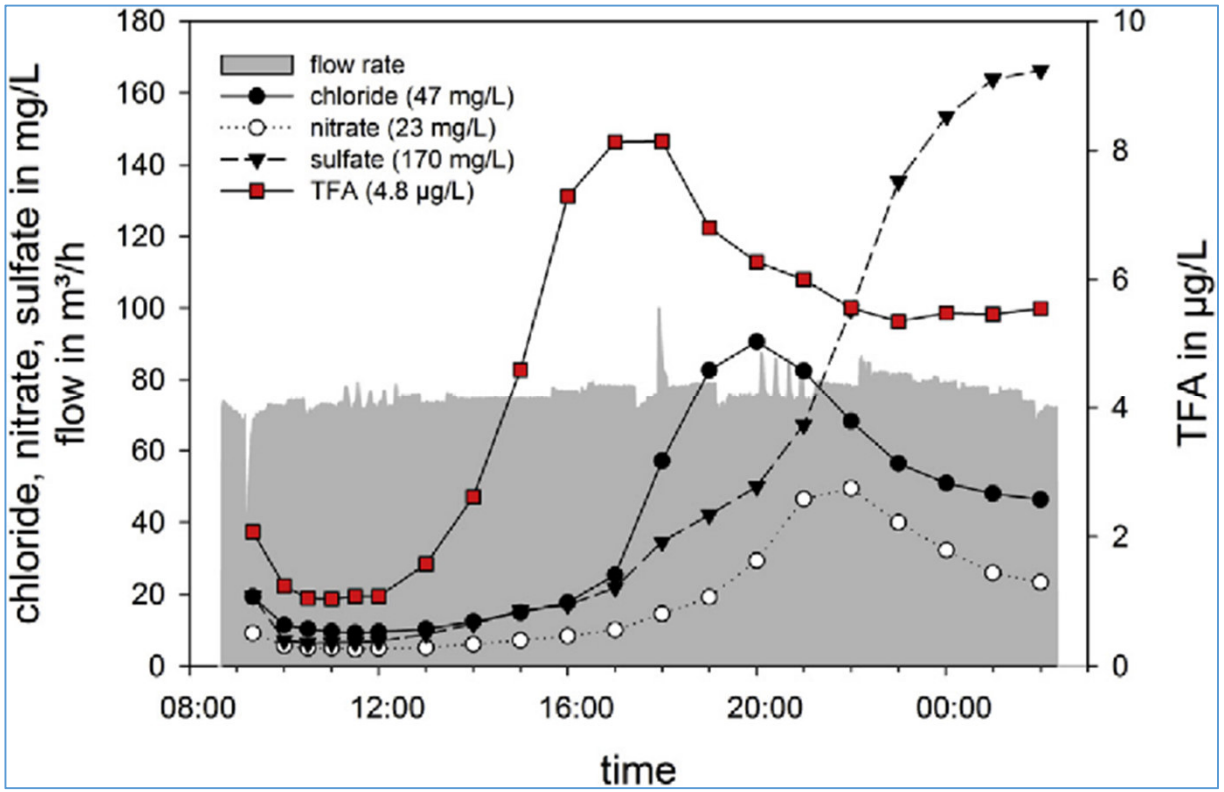
vM-substances and GAC filtration (data from small-scale filter tests)

Removal of PMT/vPvM-substances in drinking water treatment

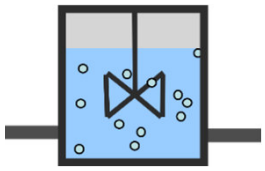


Anion exchange

- pre-treatment needed
- limited regeneration (only partial reg. from PFAS)
- disposal of regenerating solutions problematic
- removal of competitive ions (nitrates, sulphates)



Removal of PMT/vPvM-substances in drinking water treatment

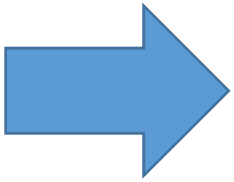


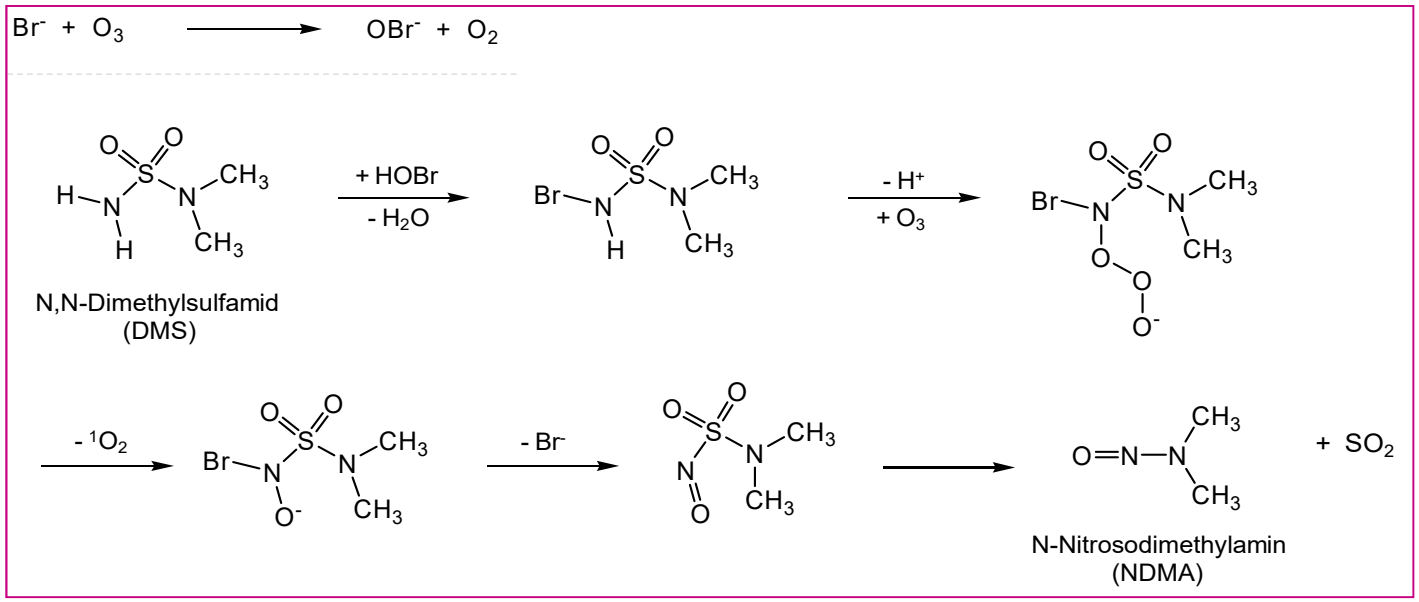
Ozonation

- Fast reaction of substances with ozone = precondition
- Often: Persistence is related to high chemical stability

- vP substances → low elimination potential
- after each O_3-step addtional AC-step is necessary
- Ozonation can form harmful by-products (e.g. NDMA)

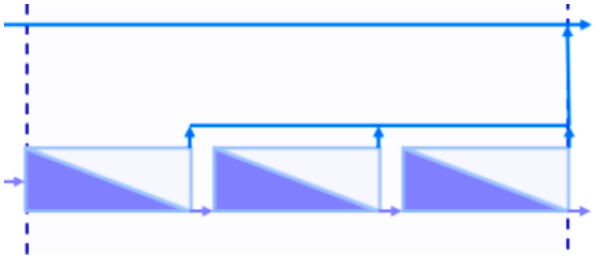
NDMA formation from N,N-dimethyl-sulfamid





von Gunten et al. (2011), EST

Removal of PMT/vPvM-substances in drinking water treatment

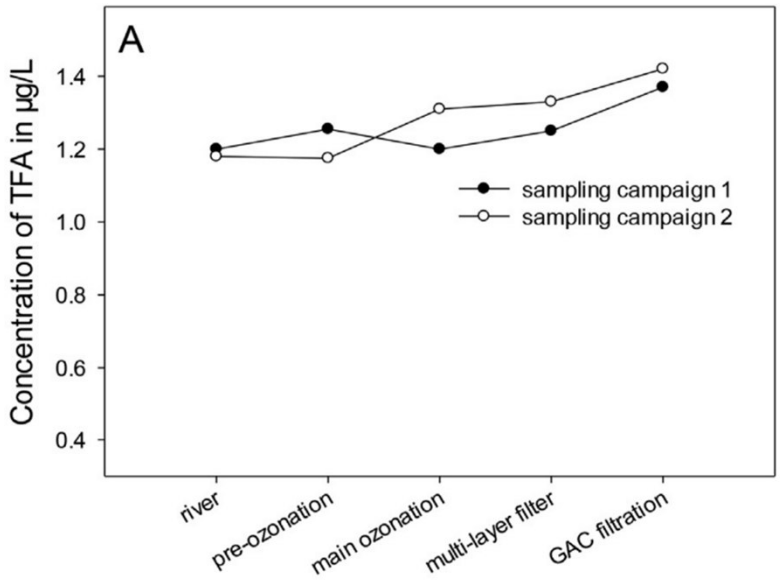


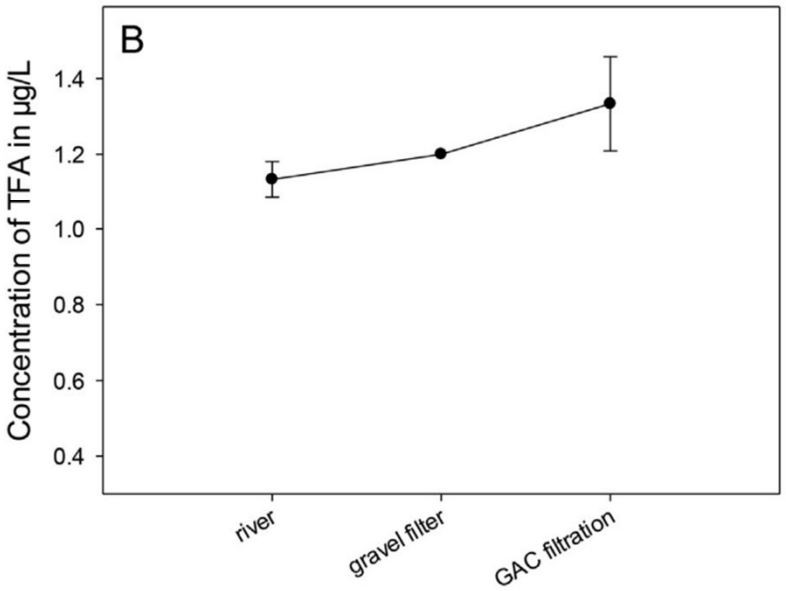
Reverse osmosis

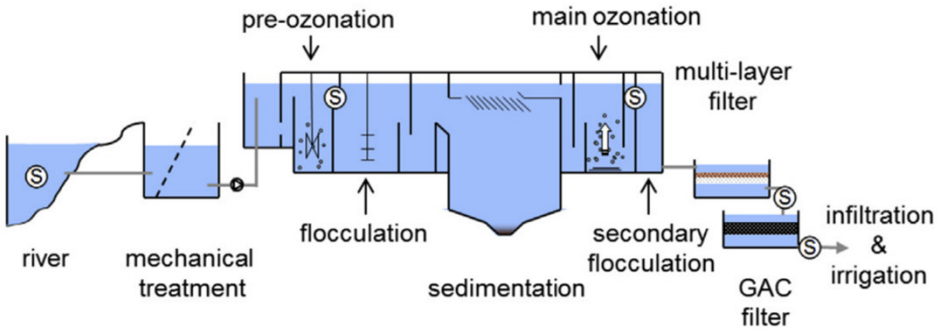
- Low molecular weight substances (MW) → low elimination potential
- MW > 200 Da → high elimination potential
- RO is expensive (> 0.5 €/m³ vs. 0.1 €/m³ for conventional treatment steps)
- needs 15-20% extra raw water to produce the same amount of drinking water
- RO is energy-intensive
- RO produces waste (brine) which is difficult to manage
- RO water has to be re-mineralised

Lipp et al. (2010) Desalination and Water Treatment 13, 226–237

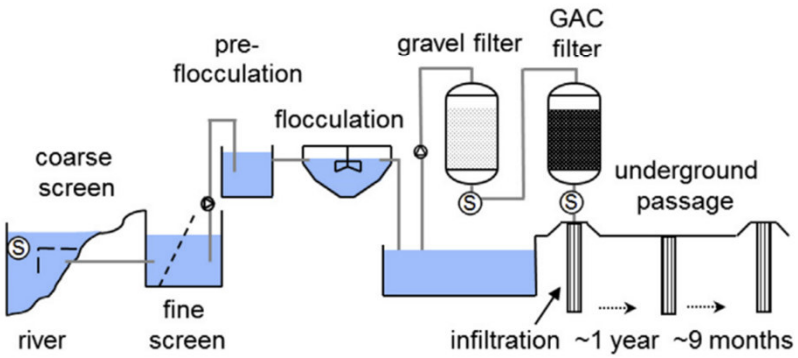
Specific case: TFA







No Removal with conventional drinking water treatment!

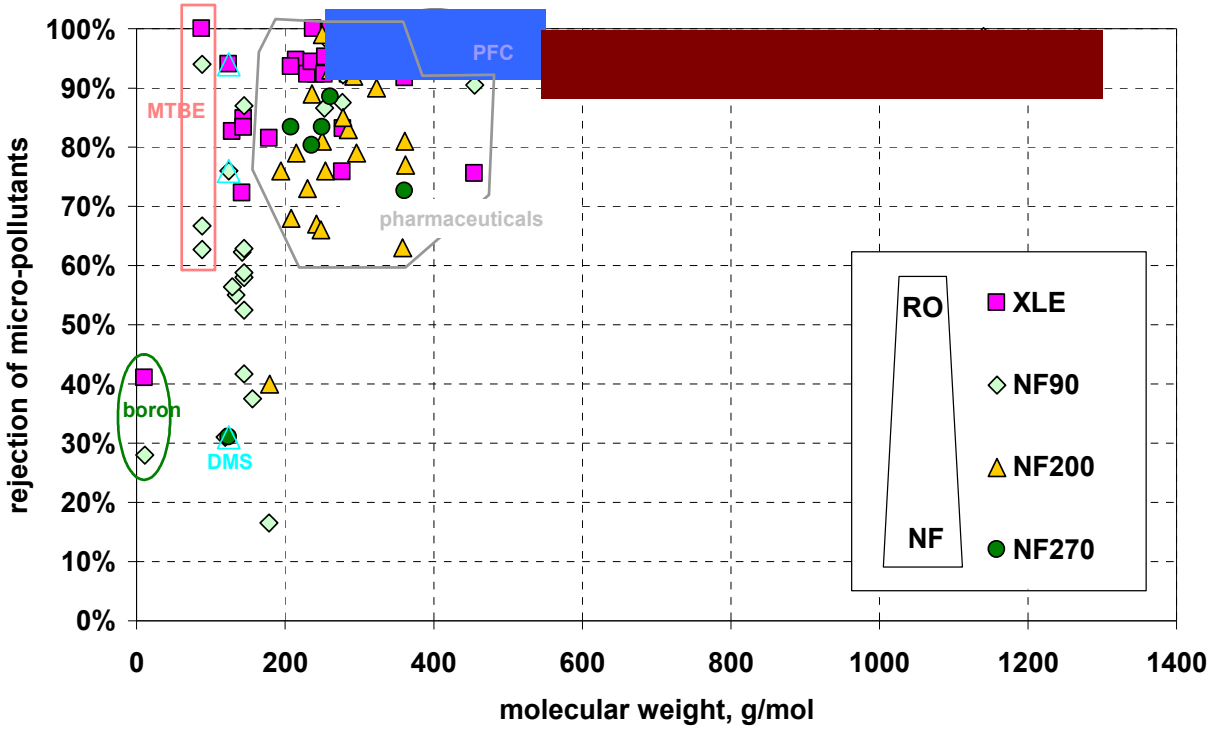


Scheurer et al. (2017) Water Res. 126, 460–471.

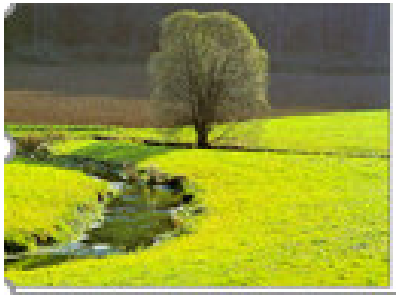
Removal of PMT/vPvM-substances in drinking water treatment: Conclusions

- PMT substances are difficult/impossible to remove during conventional drinking water treatment
  - Biological treatment does not work for persistent substances
  - GAC or PAC filtration does not work for mobile substances
  - Most PMT/vPvM-substances are also persistent towards chemical oxidation

- Reverse osmosis can remove some (but not all) PMT/vPvM-substances and has its limitations



Taking action to protect drinking water resources



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TFEU 191 (2)
Precautionary principle, polluter pays principle, control at source

European Green Deal:
Chemicals strategy, Zero-pollution ambition, PFAS action plan

REACH:
restriction for non-essential PFAS, definition essential uses, Art. 57 add PMT/vPvM to Svhc

PPP:
Art. 44 re-assessment of active substances not achieving WFD objectives

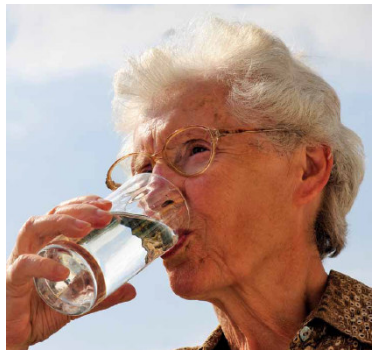
CLP:
introduce new hazard classes on PMT, apply them across all legislation

WFD:
GWD: PFAS as family
EQS: inclusion of PFAS total

Industry emissions Directive:
Address emissions & reporting from industrial plants

E-PRTR:
Address emissions & reporting from industrial plants

DWD:
Article 7/8 Risk assessment & risk management
Annex I PFAS total/Sum



Thank you for your attention

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