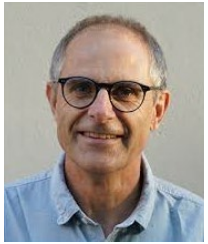
ENV-167 Introduction to Environmental Engineering - Water we use

Oct. 28th – Micropollutants in water (F. Breider)

- Sources, Fate and Behavior of Chemicals in the Environment

Oct. 30th – Bacteria and viruses in water (T. Kohn)

- Occurrence and fate of pathogens in the water cycle



Nov. 4th – Water treatment technologies (U. von Gunten)

- Water resources for drinking water, drinking water treatment including water reuse and (enhanced) wastewater treatment

Nov. 6th – Visit of Vidy wastewater treatment plant (13.15-15h)

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Central Environmental Laboratory

Sources, Fate and Effects of Chemicals in the Environment

Florian Breider

Central Environmental Laboratory
EPFL

Swiss Federal
Institute of
Technology
Lausanne

ENV-167 “Introduction to environmental engineering” October 28th 2024

Aims of this course

Gain a better understanding of:

- The diversity of chemical contaminants/pollutants
- The sources of environmental contaminants/pollutants
- The fate and behaviour of contaminants/pollutants in the different environmental compartments
- The effects of pollutants on the ecosystem and human health

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Definition (1)

A pollutant is a substance detectable in the environment, at least partially due to human activity, and that may induce adverse effects on the living organisms. Moriarty 1983

The Safe Drinking Water Act (SDWA) defines contaminant as any physical, chemical, biological or radiological substance or matter in water. The presence of contaminants does not necessarily indicate that the water poses a health risk. US-EPA

Definition (1)

A pollutant is a substance detectable in the environment, at least partially due to human activity, and that may induce adverse effects on the living organisms.

Moriarty 1983

If totally foreigner to the nature: xenobiotics

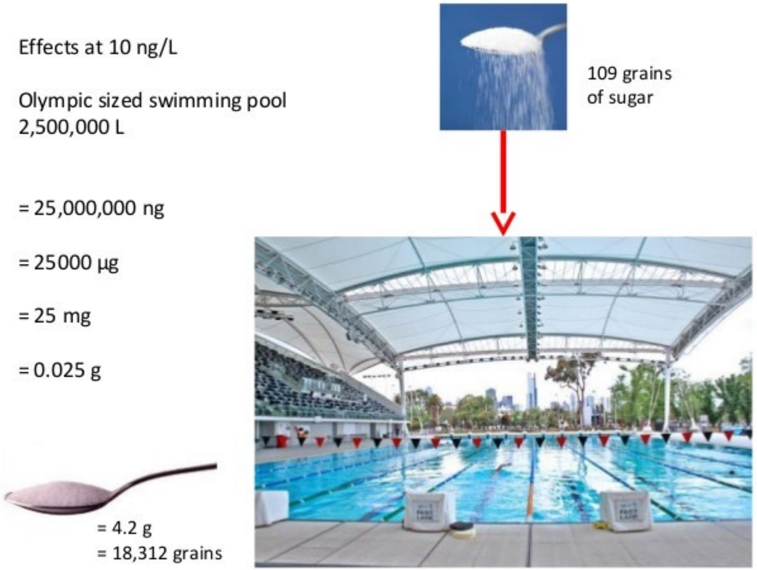
e.g. arsenic, petroleum or chloroform are not xenobiotics since they can be present naturally in rocks and/or sediments.

We can distinguish :

- Macropollutant
- Micropollutant
- Nanopollution ? (e.g. nanotubes, fullerene, graphene, metalic nanoparticles, nanoplastics)

Definition (2)

We call micropolluant a substance detectable in the environment in low concentrations (µg/l ou ng/l), partially due to human activity, and that can induce adverse effects on the living organisms at these low concentrations.



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Definition (3)

We call micropollutant a substance detectable in the environment in low concentrations (µg/l ou ng/l), partially due to human activity, and that can induce adverse effects on the living organisms at these low concentrations.

Inorganic micropollutants: heavy metals, metalloids, nitrite, nitrate…

Organic micropollutants: mostly substances produced by the industry

Definition (4)

"Emerging substances" can be defined as substances that have been detected in the environment, but which are currently not included in routine monitoring programmes at EU level and whose fate, behaviour and (eco)toxicological effects are not well understood.

"Emerging pollutants" can be defined as pollutants that are currently not included in routine monitoring programmes at the European level and which may be candidates for future regulation, depending on research on their (eco)toxicity, potential health effects and public perception and on monitoring data regarding their occurrence in the various environmental compartments.

https://www.norman-network.net/?q=node/19#:~:text=Examples%20from%20the%20LIST%20OF,endocrine%20disrupting%20compounds%20(EDCs).

Principal sources of pollution

Agriculture

Very different chemicals:
- fertilisers, phosphorus
- biocides
- antibiotics/pharmaceuticals

- emission into the air: drift
- emission into the soil
- transfer to water, sediment, groundwater

Principal sources of pollution

Industries **(mines, pharma/chemical industries)**

Very different chemicals:

- Metals
- PAHs
- N-nitrosamines

- emission into the air: smoke
- emission into the water: discharges
- emission into the soil: discharges
- transfer between compartments

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Principal sources of pollution

Cities / Leisure activities / Households

Very different chemicals:
- Pharmaceutical substances
- Biocides
- Plastics
- POPs

- emission into the air
- emission into the water
- emission into the soil
- transfer between compartments

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Principal sources of pollution

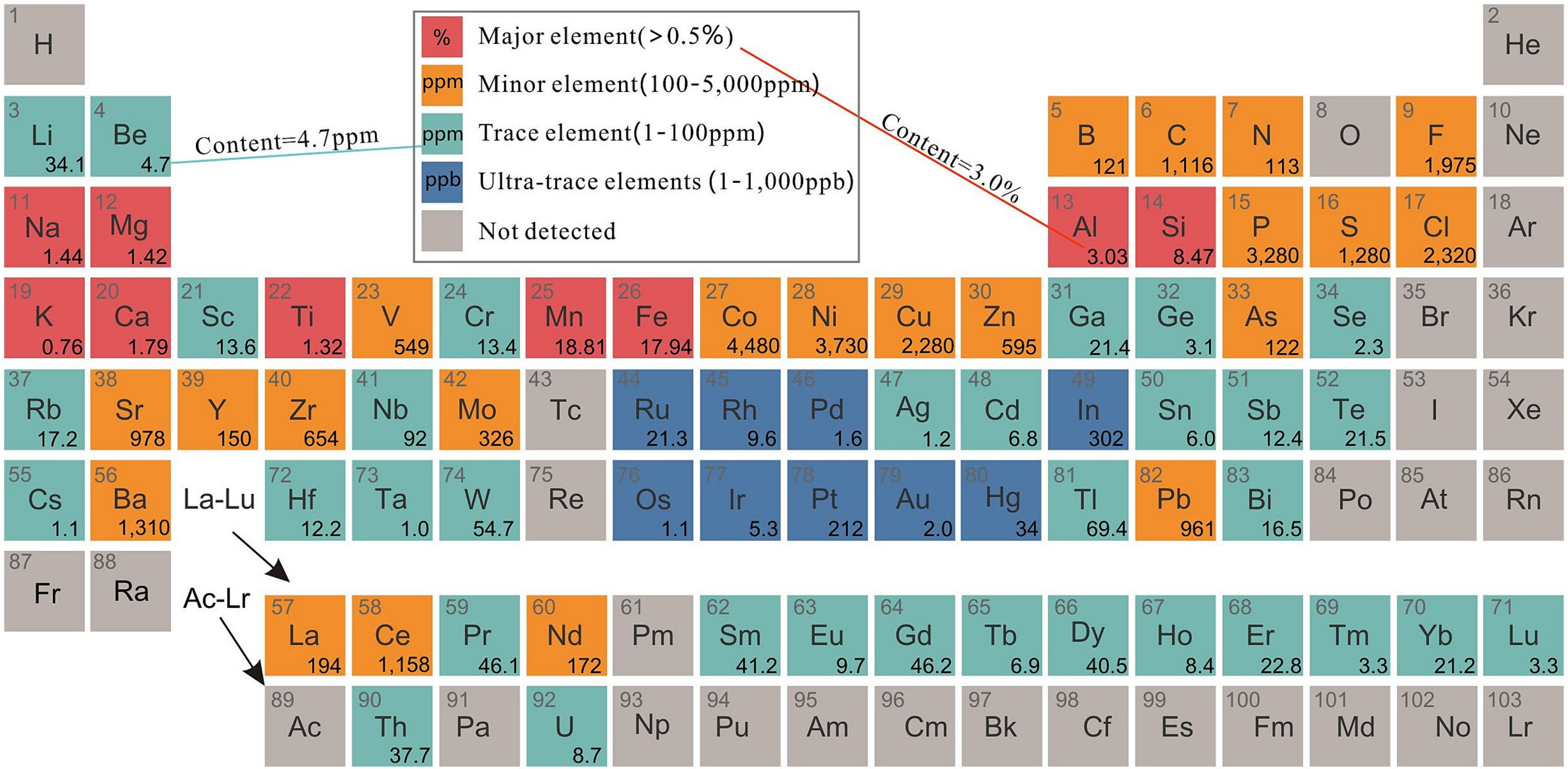
Military activities
(conflict zones, military training sites, ammunition factories)

Very different chemicals
- Heavy metals
- Radioactives materials
- Explosives
- PAHs

Armed conflicts too often lead to environmental degradation or destruction, with long-lasting effects that contribute to the increased vulnerability of the affected populations.

Inorganic pollutants

Inorganic pollutants



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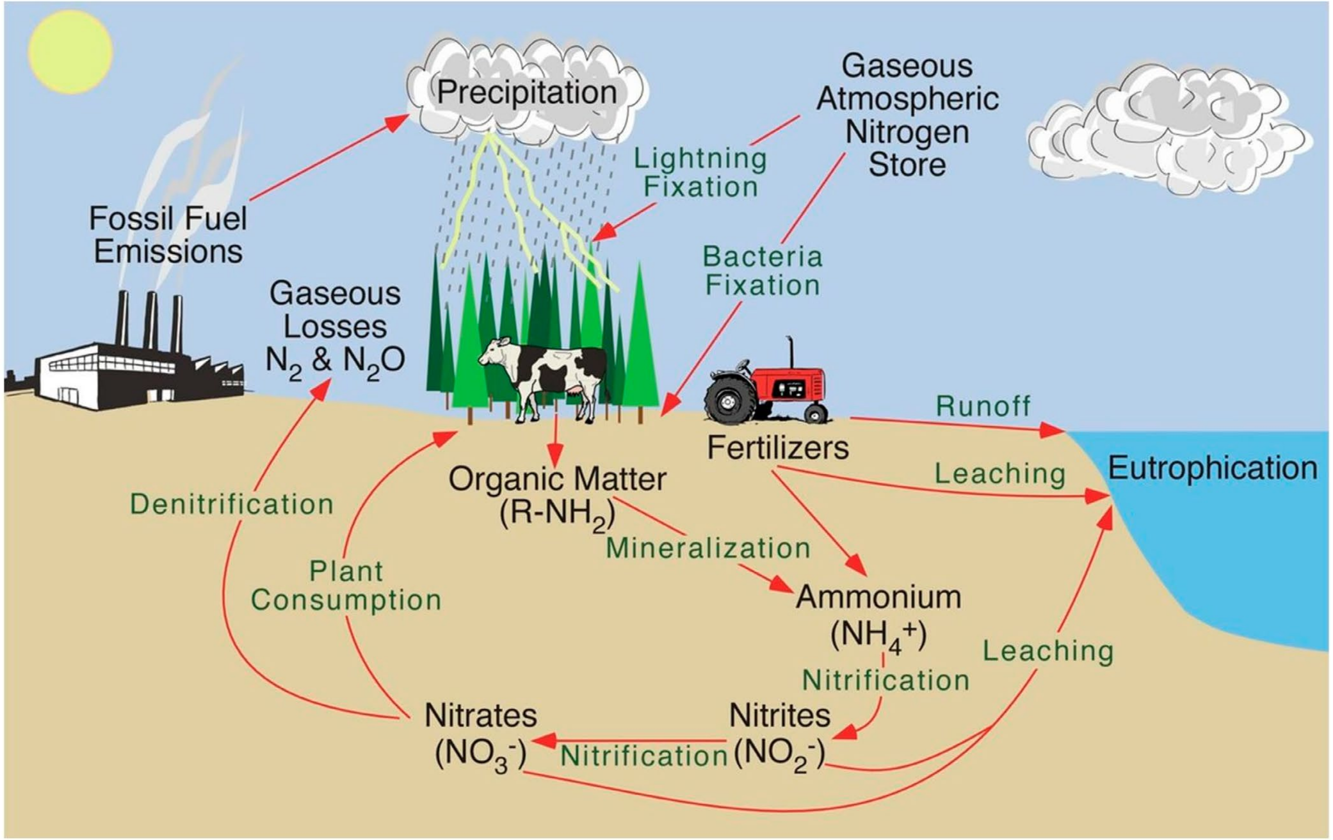
Ren et al. 2024 https://doi.org/10.1016/j.gloplacha.2024.104498

Inorganic pollutants

NO_2^-/NO_3^-



Moloantoa et al. 2022 https://doi.org/10.3390/w14050799

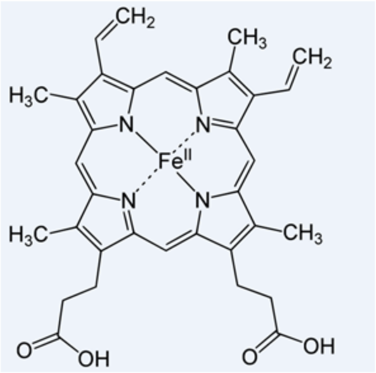
Inorganic pollutants

NO_2^-/NO_3^-

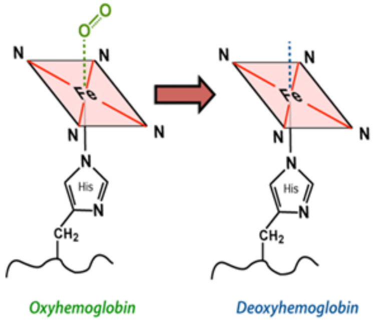
High concentrations of nitrite in freshwater ecosystems can be toxic to aquatic organisms. These living organisms can capture nitrites from water through their cells, subsequently undergoing the oxidation of their respiratory pigments (hemoglobin, hemocyanin). Since NO2- and Cl- ions compete for the same active transport site, high chloride concentrations in the aquatic environment have the potential to reduce nitrite toxicity.

Molluscs, crustaceans — Vertebrates

Hemocyanin	Hemoglobin
Preforms better in cold environments with low oxygen pressure	Preforms better in oxygen rich environments
Contains copper linking other parts of the molecule	Contains iron surrounded by atoms of carbon, nitrogen, and hydrogen
Binds with oxygen non co-operatively most of the time (when non co-operatively, is one quarter as efficient as hemoglobin)	Binds with oxygen co-operatively all of the time
Free floating in blood	Connected to red blood cells



Heamoglobin

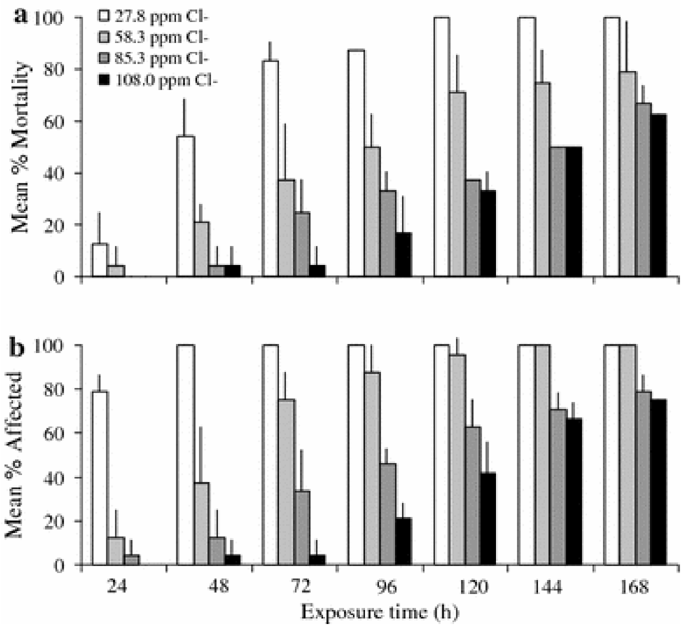


Inorganic pollutants

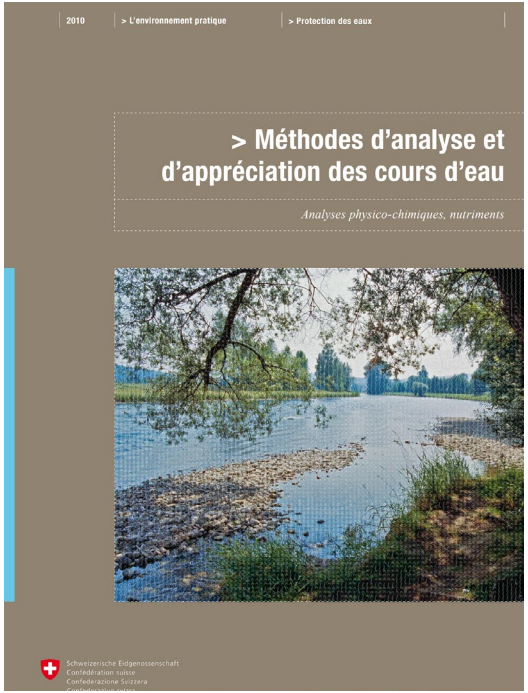
NO_2^-/NO_3^-

Eulimnogammarus toletanus

Antagonist effect of chloride on nitrite toxicity



Mean percentages (+SD) of mortality (a) and affected individuals (b) for Eulimnogammarus toletanus exposed to 5.1 ppm NO_2-N through seven different exposure times (hours) and at four different chloride concentrations (ppm Cl^-)



Appréciation	Nitrites [mg/L N][7] (<10 mg/L Cl^-)	Nitrites [mg/L N] (10 à 20 mg/L Cl^-)	Nitrites [mg/L N] (>20 mg/L Cl^-)
très bon	jusqu'à < 0,01	jusqu'à < 0,02	jusqu'à < 0,05
bon	0,01 à < 0,02	0,02 à < 0,05	0,05 à <0,10
moyen	0,02 à < 0,03	0,05 à < 0,075	0,10 à < 0,15
médiocre	0,03 à < 0,04	0,075 à < 0,10	0,15 à < 0,20
mauvais	0,04 et plus	0,10 et plus	0,20 et plus

Système Modulaire Gradué

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Inorganic pollutants

"Heavy" metals, metalloids (Al, As, Cd, Cr, Cu, Pb, Hg,...)

- **Natural contamination:** Bangladesh, Vietnam…
- **Agriculture:** pesticides, sluges,…
- **Runoff water:** streets, railways,…
- **Industry, mines**

Caution: they will not degradate but they can be transformed!

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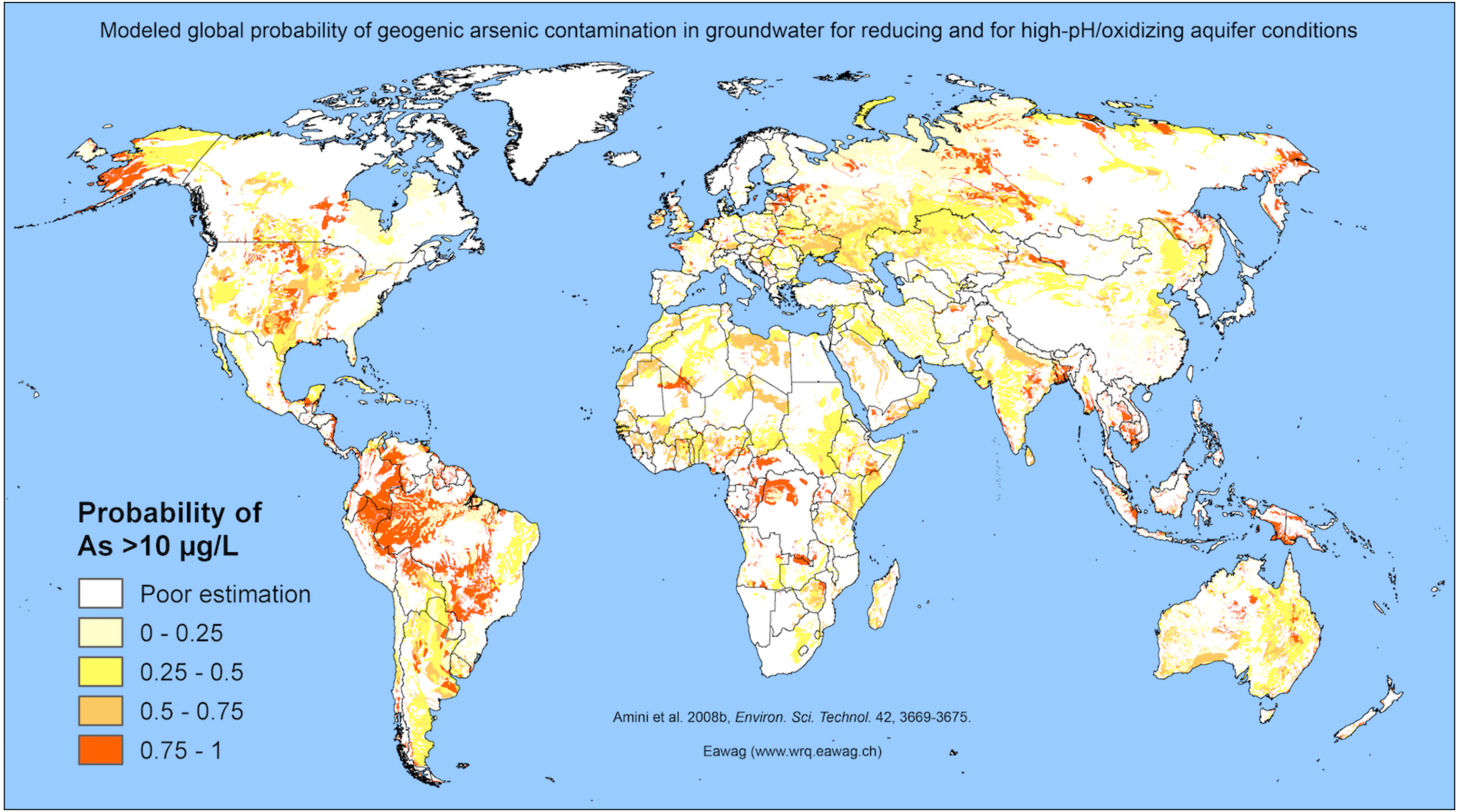
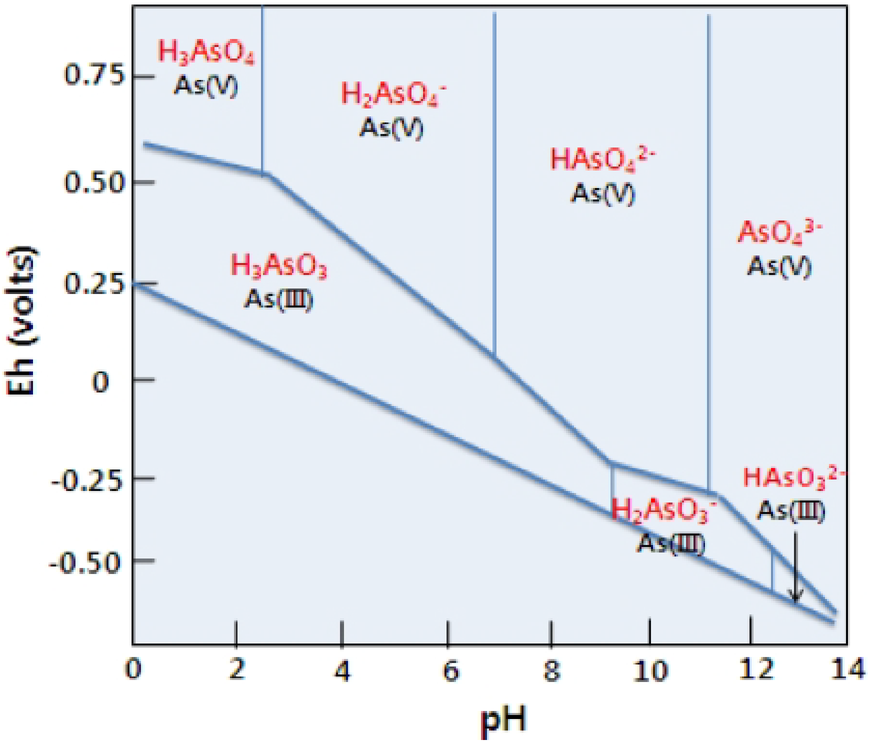
Inorganic pollutants

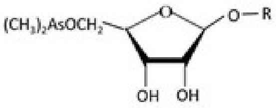
Speciation and toxicity of arsenic



Inorganic pollutants

Speciation and toxicity of arsenic

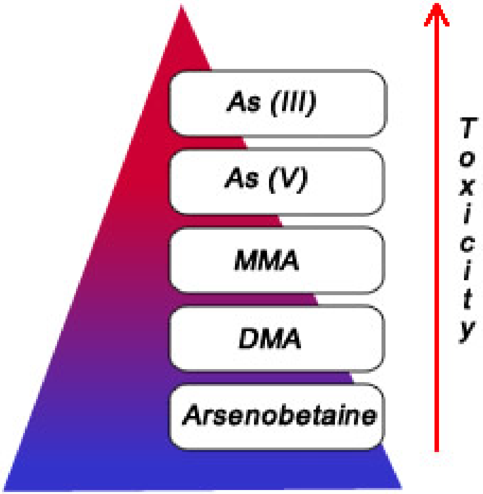


Arsenic compound	Formula	Abbreviation
Arsenous acid, arsenite	H_3AsO_3	As(III)
Arsenic acid, arsenate	H_3AsO_4	As(V)
Monomethylarsonic acid	$CH_3AsO(OH)_2$	MMA
Dimethylarsinic acid	$(CH_3)_2AsO(OH)$	DMA
Trimethylarsine oxide	$(CH_3)_3AsO$	TMAO
Arsenobetaine	$(CH_3)_3AsCH_2COOH$	AsB
Arsenocholine	$(CH_3)_3AsCH_2CH_2OH$	AsC
Tetramethylarsonium ion	$(CH_3)_4As^+$	TETRA
Arsenosugars		As-sugars
Arsenolipids		As-lipids

R = glycerol, phosphate, sulphonate or sulphate

Inorganic pollutants

Speciation and toxicity of arsenic



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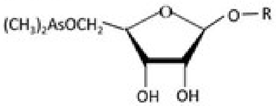
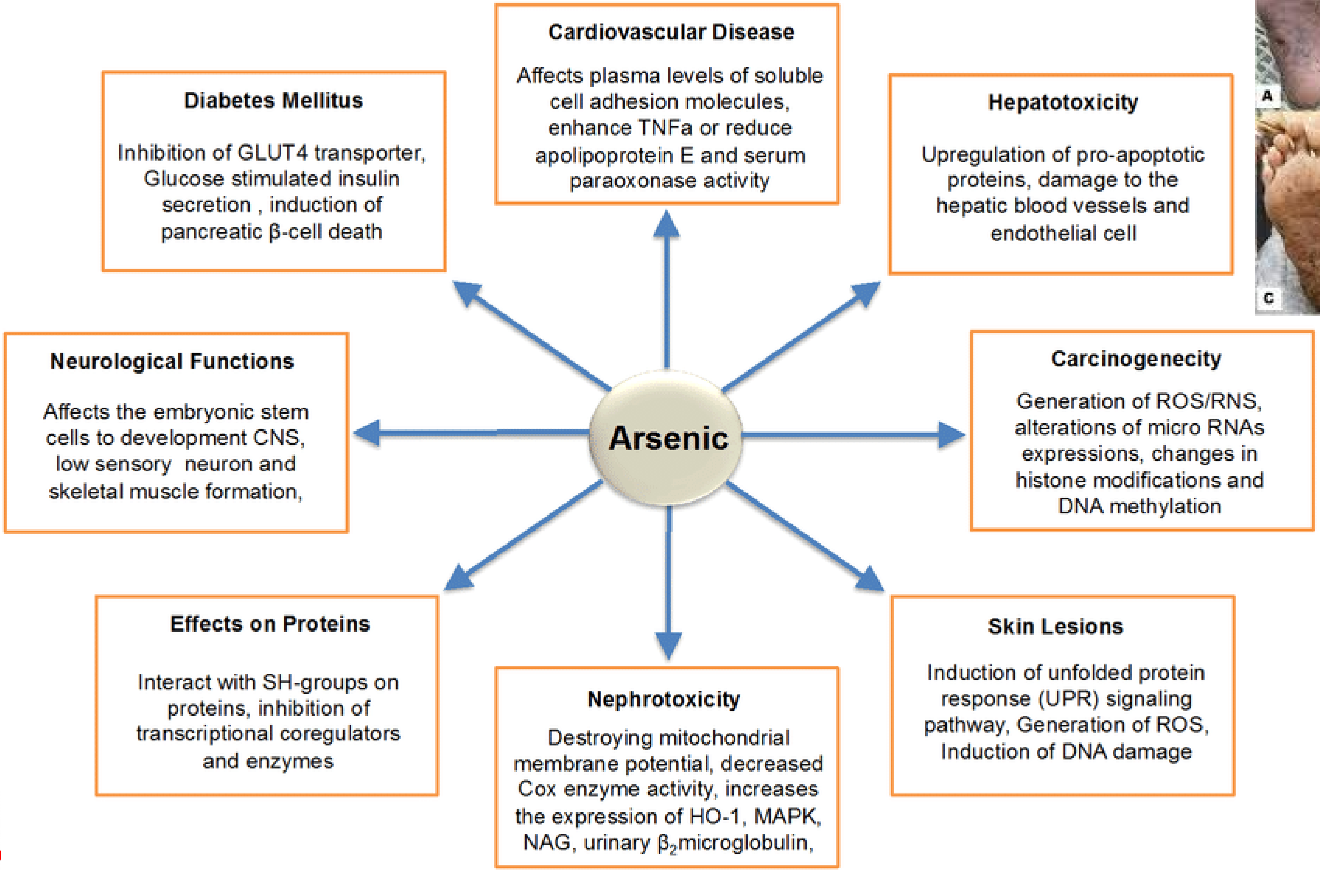
Arsenobetaine	$(CH_3)_3AsCH_2COOH$	AsB
Arsenocholine	$(CH_3)_3AsCH_2CH_2OH$	AsC
Tetramethylarsonium ion	$(CH_3)_4As^+$	TETRA
Arsenosugars		As-sugars
Arsenolipids		As-lipids

R = glycerol, phosphate, sulphonate or sulphate

Inorganic pollutants

Speciation and toxicity of arsenic



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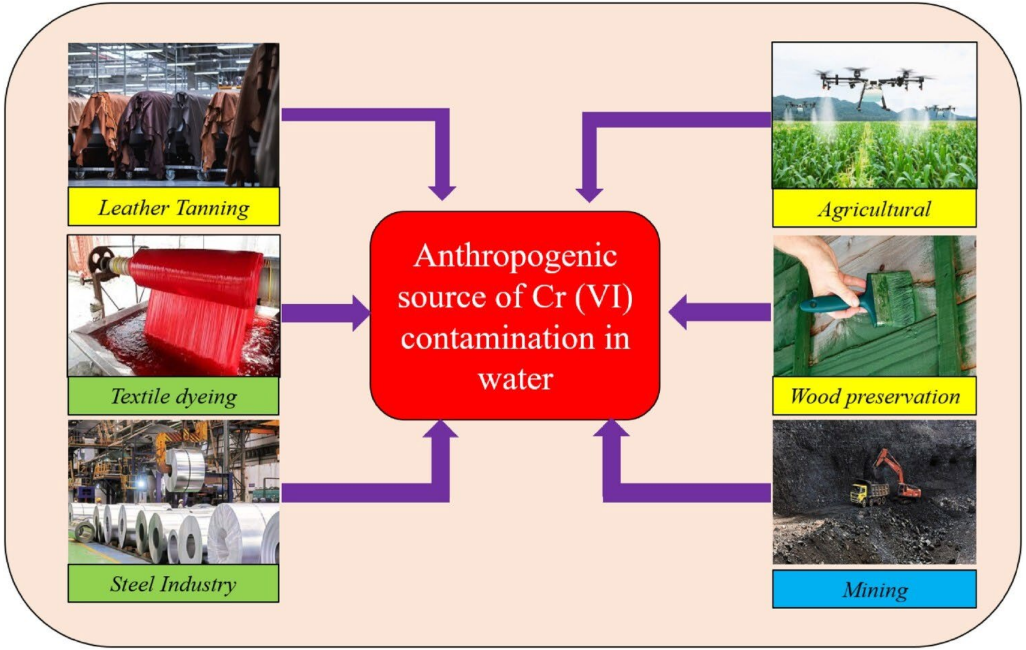
Inorganic pollutants

Speciation and toxicity of chromium

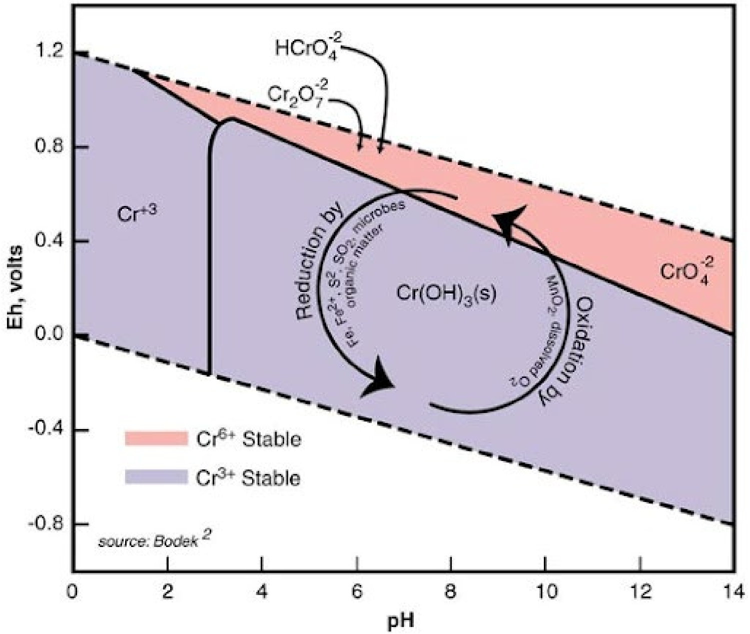


Geogenic and anthropogenic sources

Xie 2024 https://doi.org/10.1080/17518253.2024.2356614

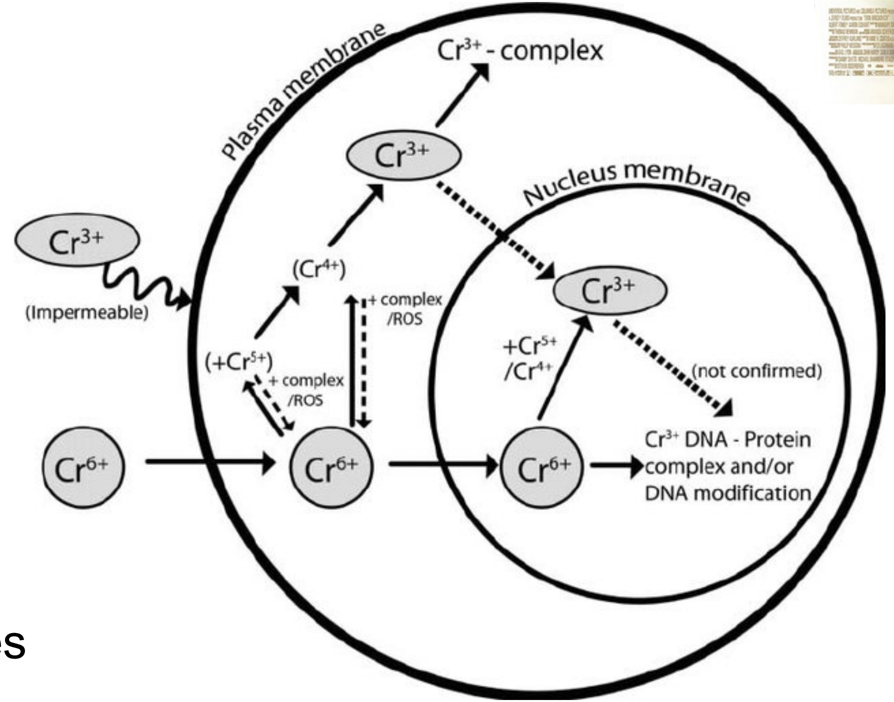
Inorganic pollutants

Speciation and toxicity of chromium



Geogenic and anthropogenic sources

Cr^{6+} is more toxic than Cr^{3+}



Narayani et al 2011 - DOI: 10.1080/10643389.2011.627022

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Organic Micropollutants

Micropollutants

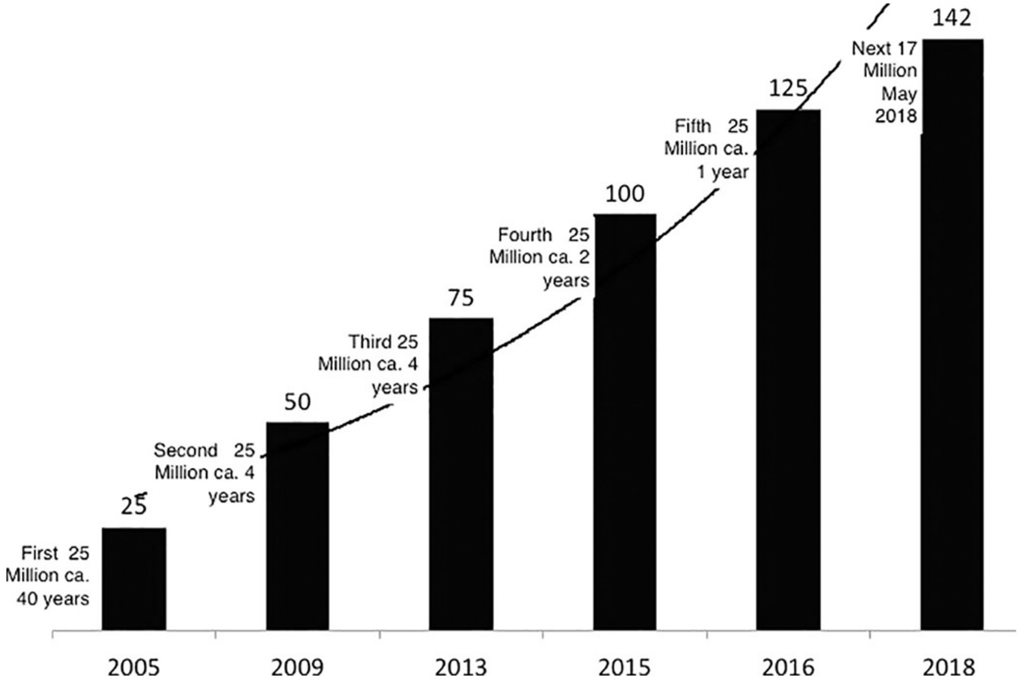
Diversity of micropollutants

More than **142,000 chemical** substances are in commerce in the EU (2018).

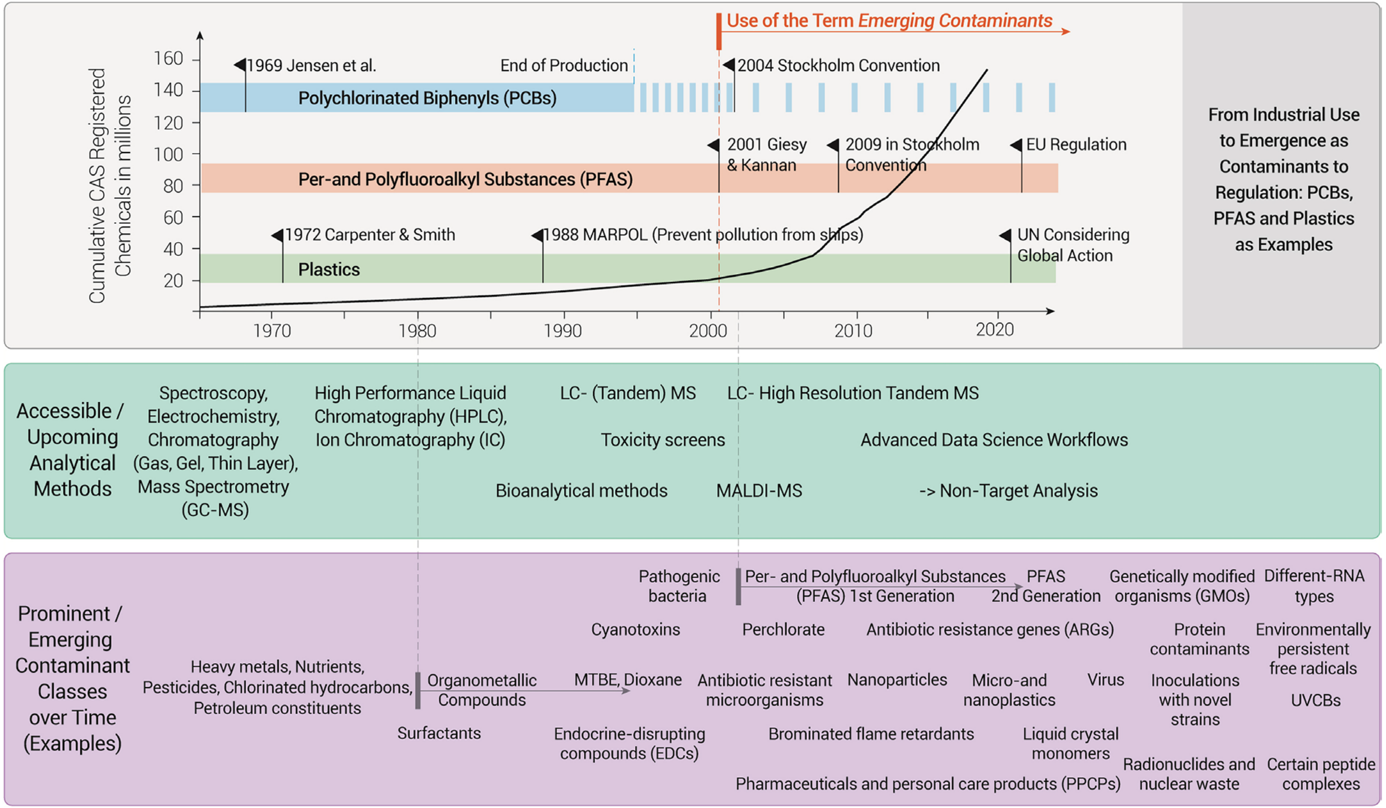
There are over **180 million** unique chemical substances registered with CAS (Chemical Abstracts Service)

15,000 to 25,000 new substances are added to this list (CAS) every day.

ACS www.cas.org



Micropollutants



Wang et al., Emerging contaminants: A One Health perspective, The Innovation, Volume 5, Issue 4, 2024,100612, ISSN 2666-6758,
https://doi.org/10.1016/j.xinn.2024.100612..

Micropollutants

Sources of micropollutants

Cosmetic
Pharmaceutical
Perfumes
Dyes
Pesticides, herbicides, fungicides
Plastics
Additives
Non-stick substances
Flame retardants
...

The multifaceted pathways of environmental contaminant (EC) production, utilization, and environmental release

Wang et al., Emerging contaminants: A One Health perspective, The Innovation, Volume 5, Issue 4, 2024,100612, ISSN 2666-6758, https://doi.org/10.1016/j.xinn.2024.100612..

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Micropollutants

Fate of micropollutants

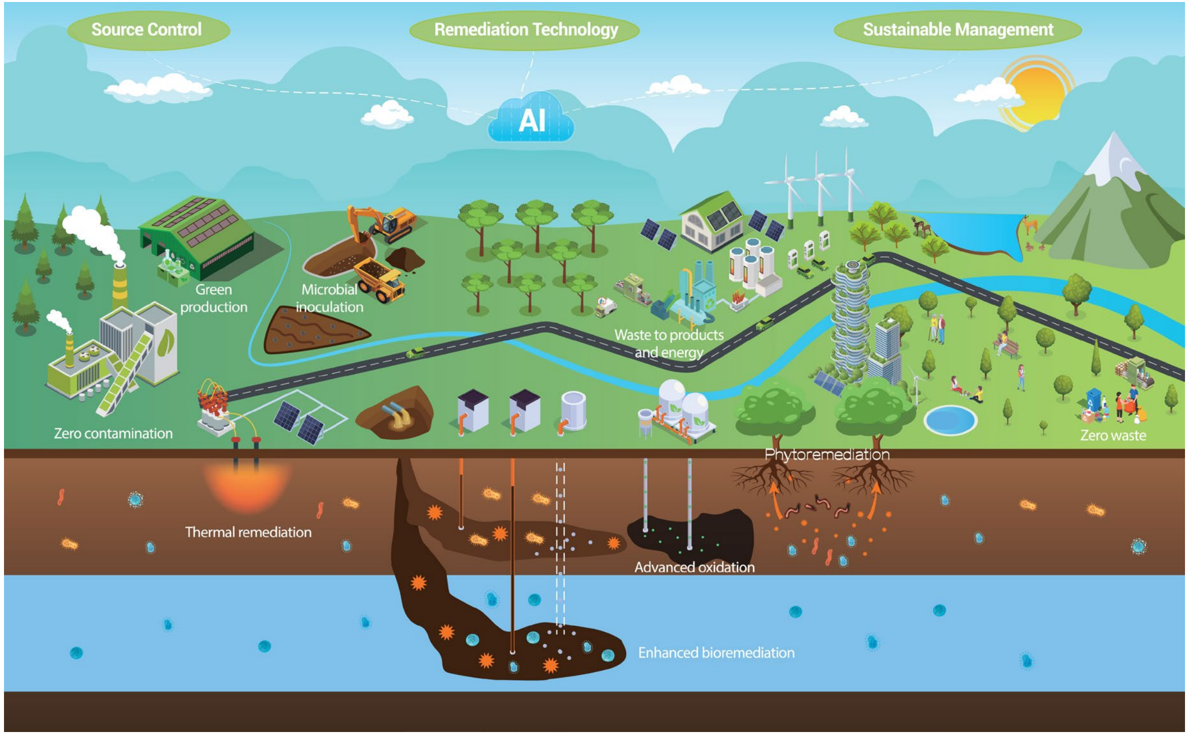
ECs can originate from various sources, such as industrial discharges, agricultural runoff, and wastewater effluents. Once released, ECs can undergo transformation processes such as degradation, volatilization, and bioaccumulation, influencing their distribution across different environmental compartments, including water bodies, soils, and the atmosphere.

Pathways through which ECs enter the environment and their subsequent fate

Wang et al., Emerging contaminants: A One Health perspective, The Innovation, Volume 5, Issue 4, 2024,100612, ISSN 2666-6758, https://doi.org/10.1016/j.xinn.2024.100612..

Micropollutants

Strategies for controlling ECs encompass various measures, including pollution control at the source, sustainable remediation to clean up contaminated sites, and sustainable management practices to prevent contamination.



Wang et al., Emerging contaminants: A One Health perspective, The Innovation, Volume 5, Issue 4, 2024,100612, ISSN 2666-6758, https://doi.org/10.1016/j.xinn.2024.100612..

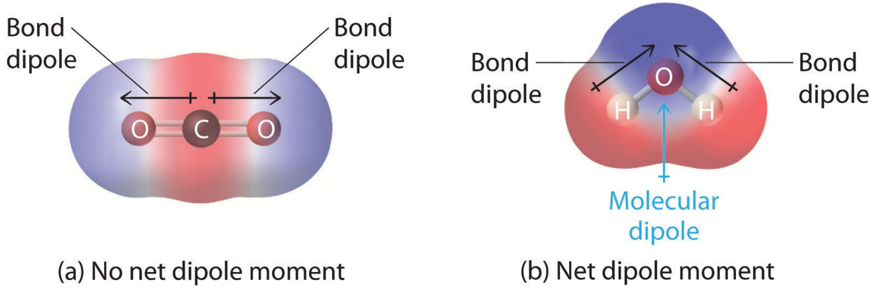
Definition

Ionic, polar and non-polar substances

In chemistry, polarity is a characteristic describing the distribution of negative and positive charges in a dipole. The polarity of a bond or molecule is due to the difference in electronegativity between the chemical elements that compose it, the differences in charge it induces, and their distribution in space. The more asymmetrically the charges are distributed, the more polar a bond or molecule will be, and conversely, if the charges are distributed in a totally symmetrical way, it will be non-polar.

Polar: water, sucrose, ... -> hydrophilic

Non-polar: hydrocarbons, ... ->hydrophobic / lipophilic

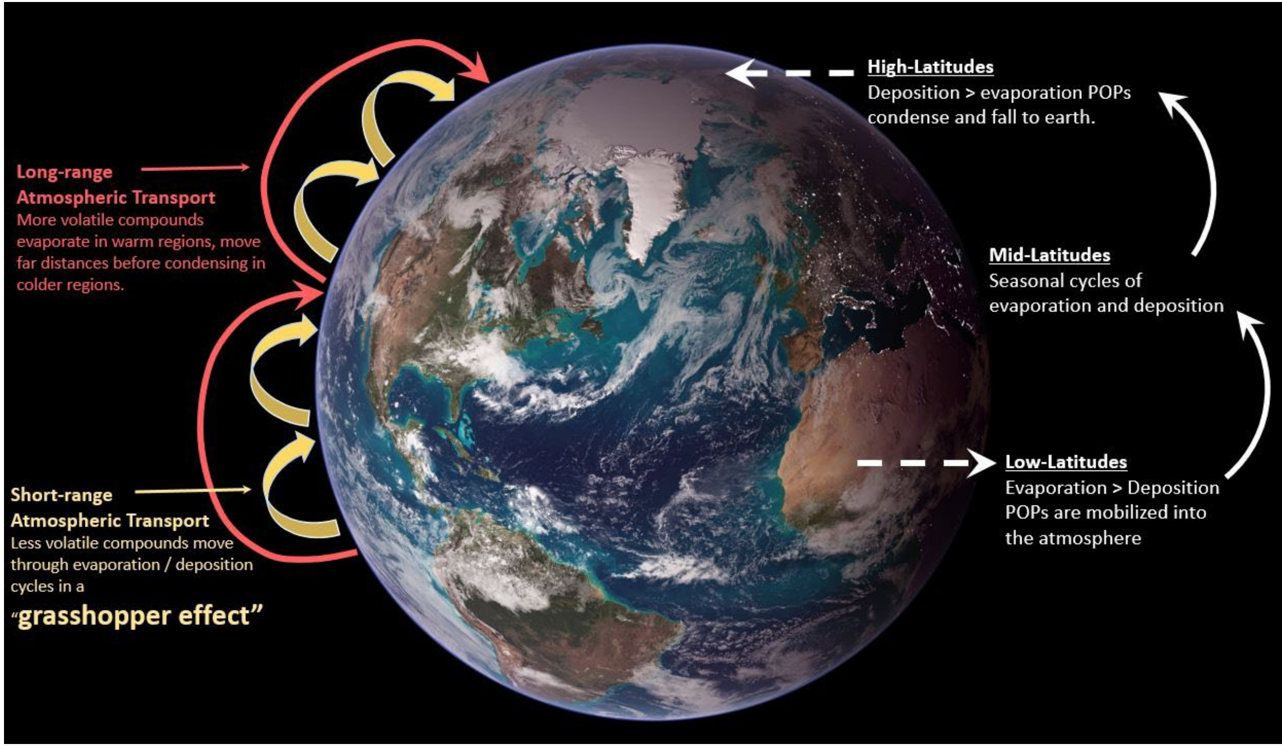


Non-polar micropollutants & persistant organic pollutants (POPs)

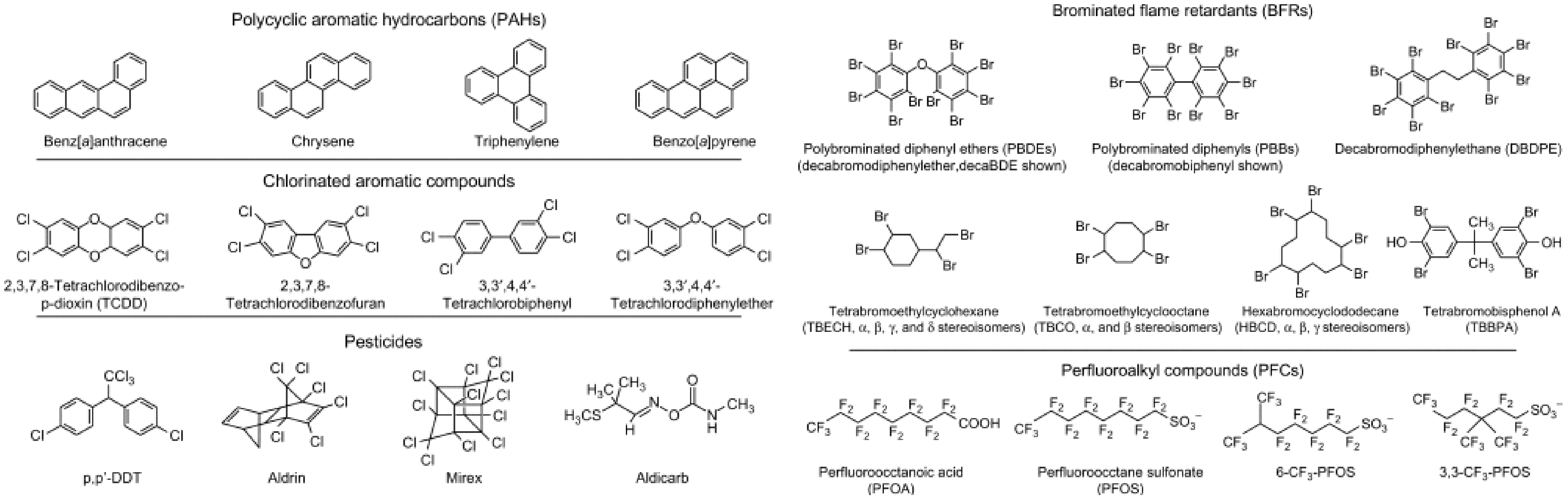
Non-polar micropollutants & Persistant organic pollutants (POPs)

Problematic properties of certain micropollutants

- Degrade poorly in the environment (POPs)
- Have a short-term and/or long-term toxic effect
- Disperse in the environment (LRT: long range transport)
- Accumulate in food chains

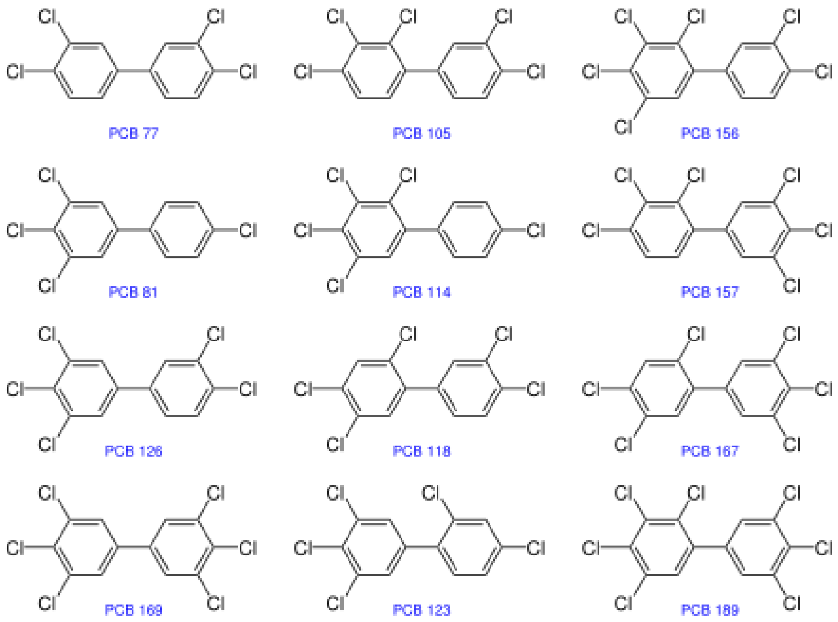


Non-polar micropollutants & Persistant organic pollutants (POPs)



Non-polar micropollutants & Persistant organic pollutants (POPs)

PCBs – Polychlorinated Biphenyls

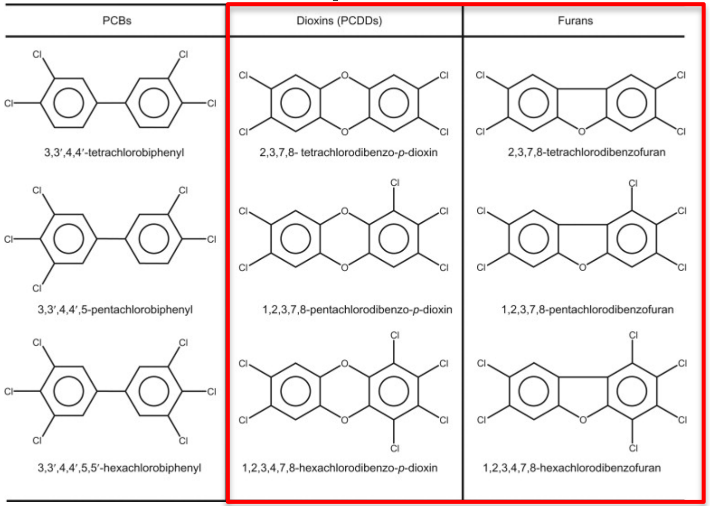


Switzerland: First regulations in 1972, ban in 1986

- Persistent organic pollutants
- 209 PCB congénères
- Fat soluble
- Classified dioxin-like PCBs as human carcinogens
- Endocrine disruptors
- Bioaccumulation

Non-polar micropollutants

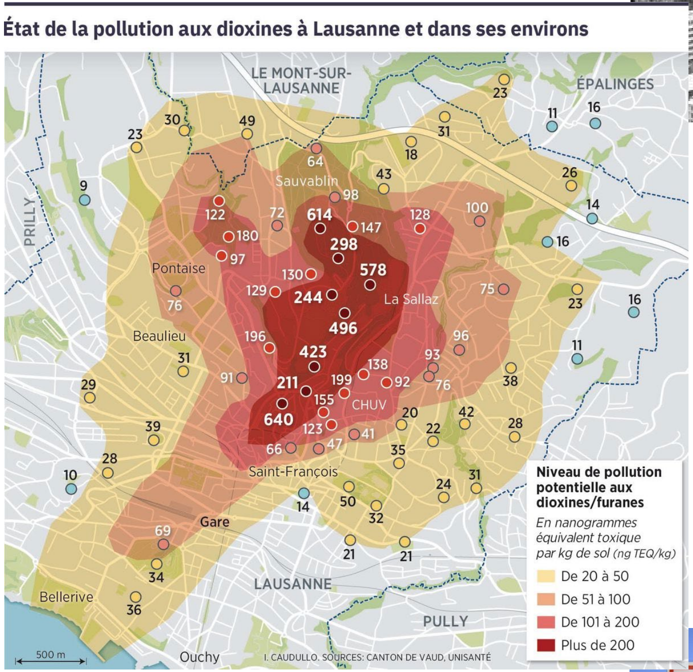
Dioxins & furans pollution in Lausanne



https://doi.org/10.1016/B978-0-12-800159-2.00019-1

75 dioxin and 135 furan congeners

unintentionally formed pollutants



Sources: incineration, combustion, industrial…
Effects: cancer, respiratory, cardiovascularem, neurological and reproductive disorders

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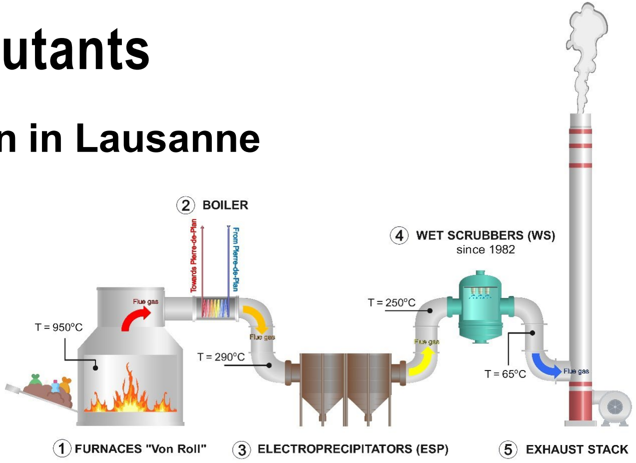
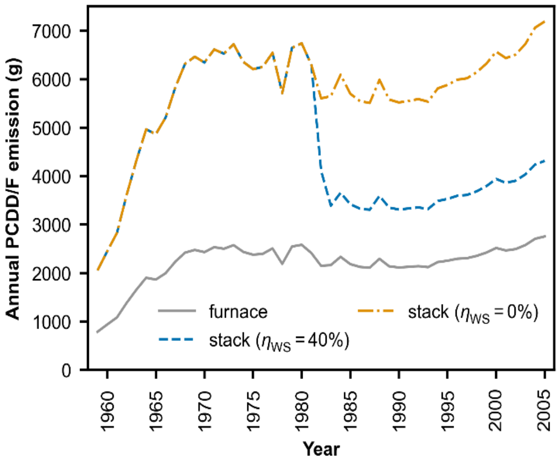
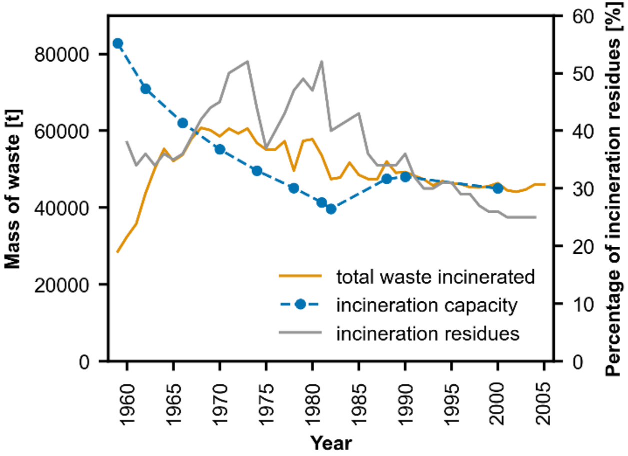
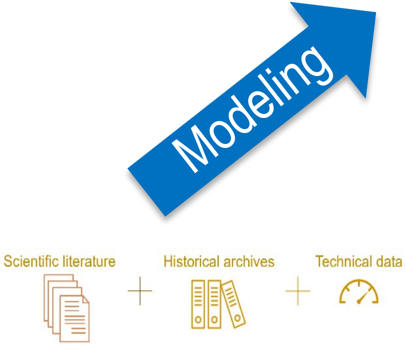
Non-polar micropollutants

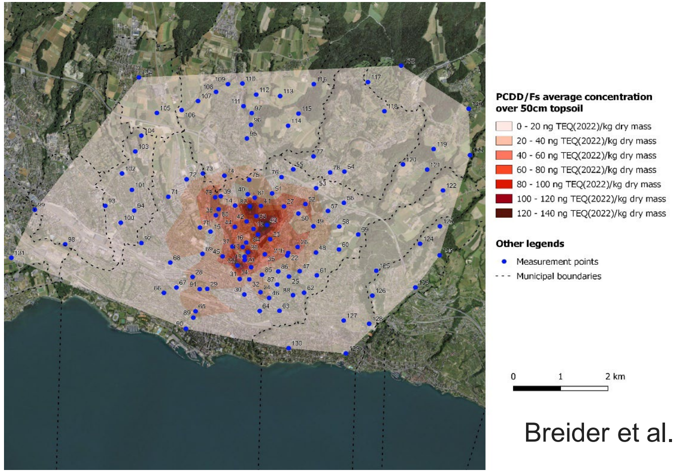
Dioxins & furans pollution in Lausanne











Breider et al., 2024

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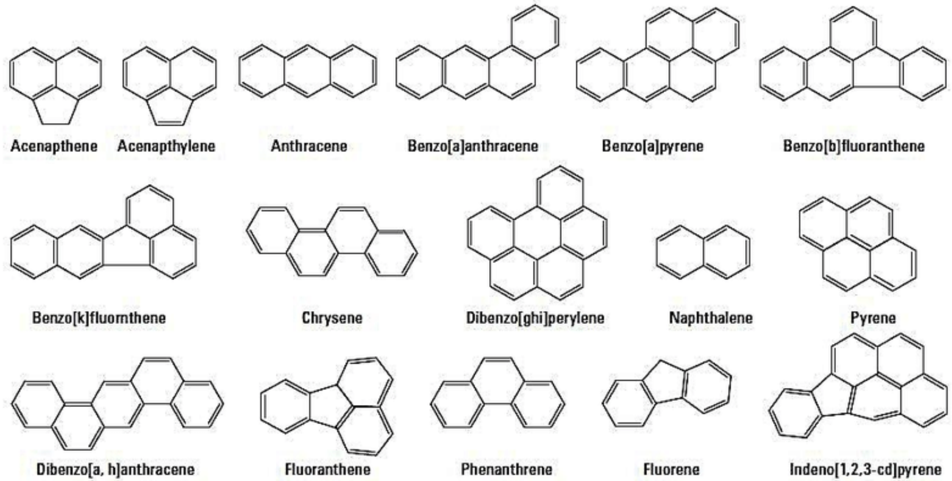
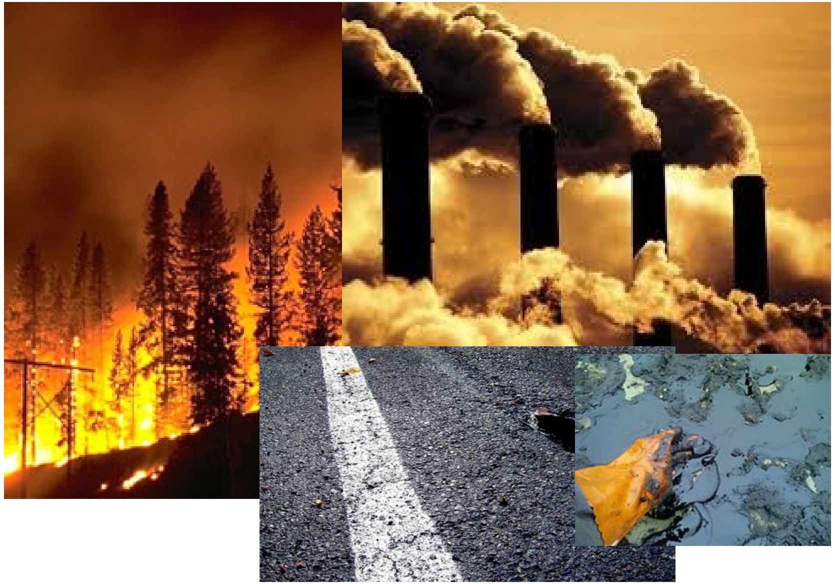
Non-polar micropollutants

PAHs – PolyAromatic Hydrocarbons

HAP – Hydrocarbures aromatiques polycycliques



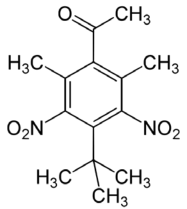
- Persistent organic pollutant
- Linked to skin, lung, bladder, liver, and stomach cancers
- Cardiovascular disease
- Developmental impacts



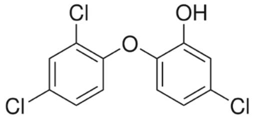
Polar micropollutants

Polar micropollutants

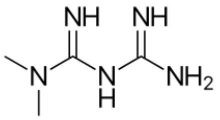
PPCP – Pharmaceutical and Personal Care Products



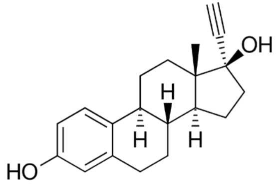
Musk ketone



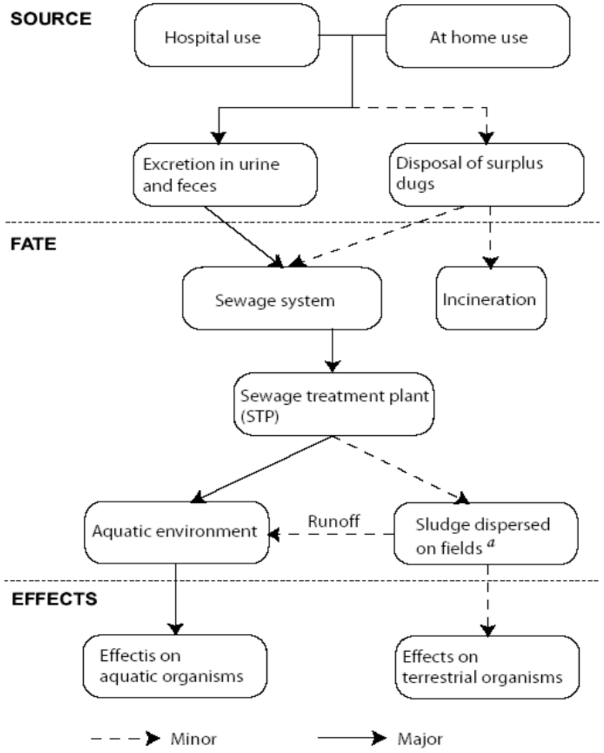
Triclosan



Metformin



Ethinylestradiol



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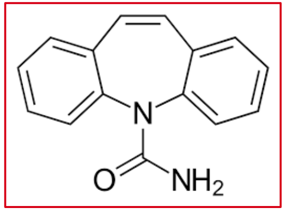
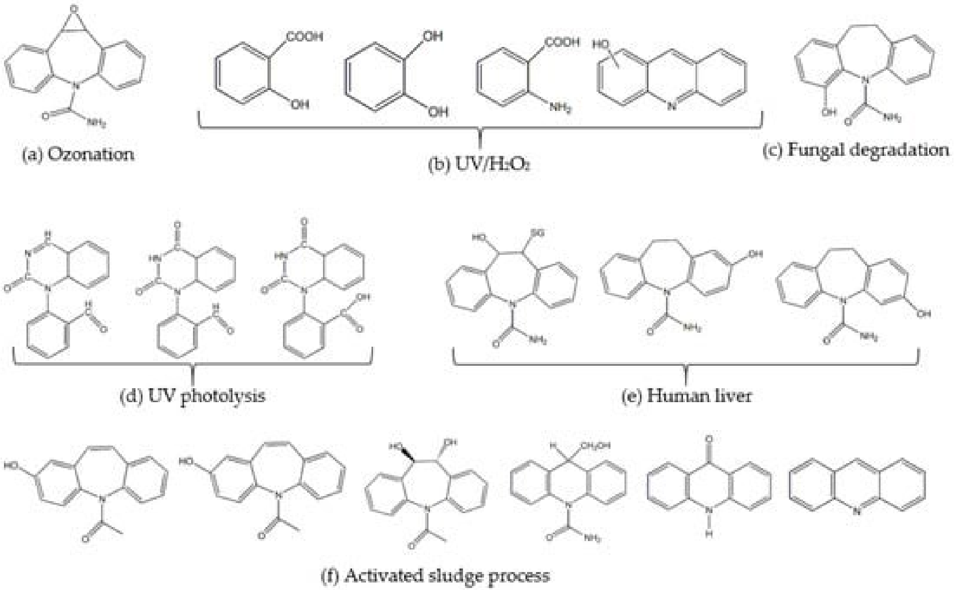
Polar micropollutants

PPCP – Pharmaceutical and Personal Care Products



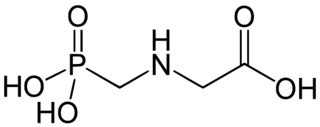
Carbamazepine an antiepileptic and a mood stabilizer, is often detected in the environment primarily through its metabolite, carbamazepine-10,11-epoxide



Polar micropollutants

Agrochemical substances

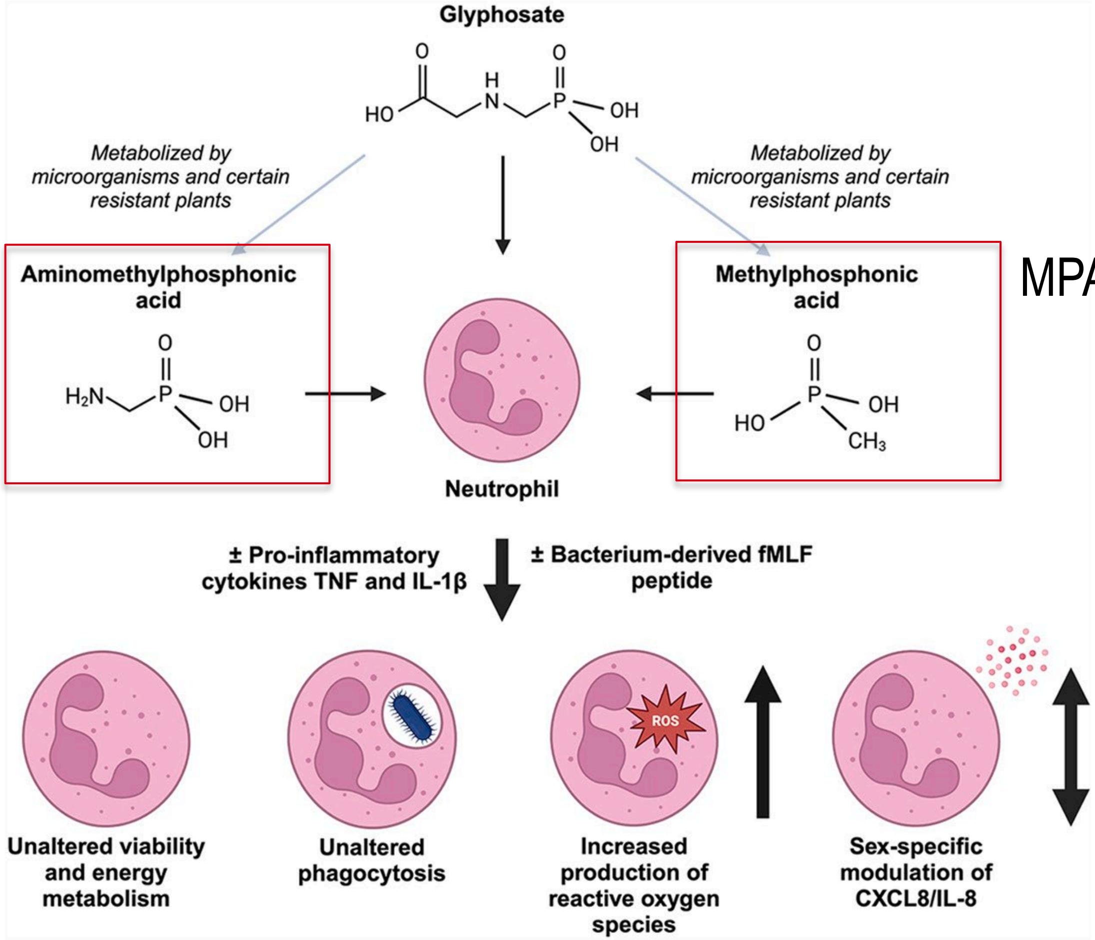
Glyphosate (herbicide)



Polar micropollutants

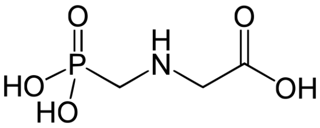
Agrochemical substances

AMPA



MPA

Glyphosate (herbicide)



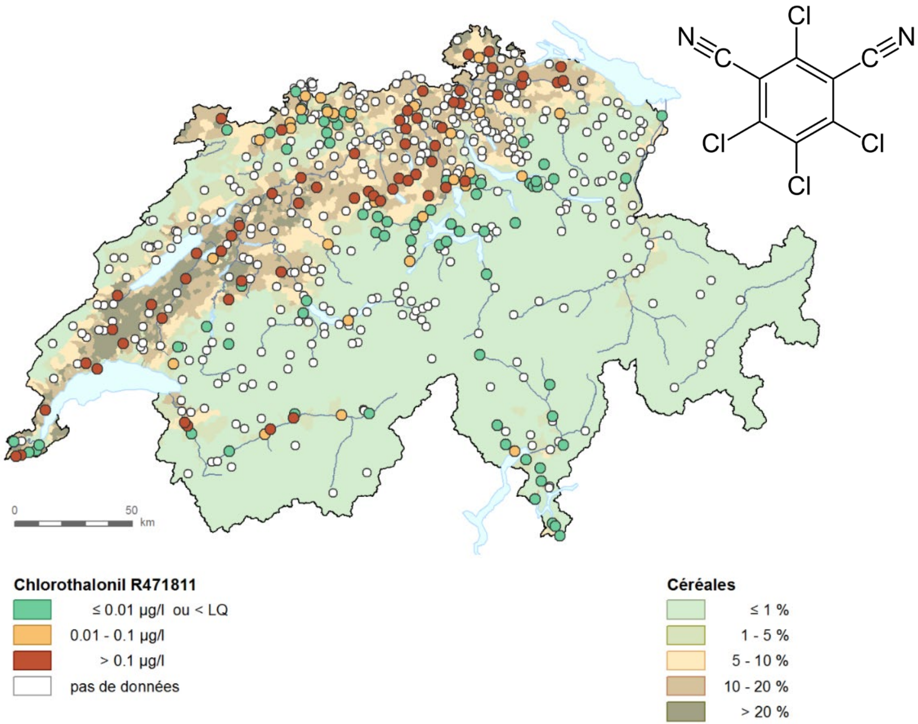
Leblanc et al. 2024 https://doi.org/10.1016/j.envres.2024.118831

EPFL

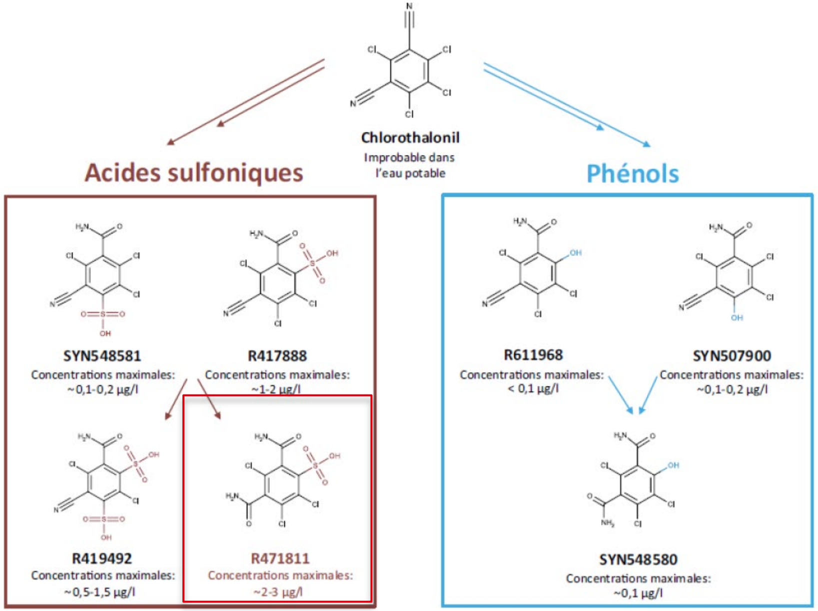
Polar micropollutants

Agrochemical substances

Chlorothalonil was registered by the Federal Office for Agriculture (FOAG) in the 1970s. It was used on cereals, vegetables, potatoes, vines and ornamental plants to combat diseases such as mildew

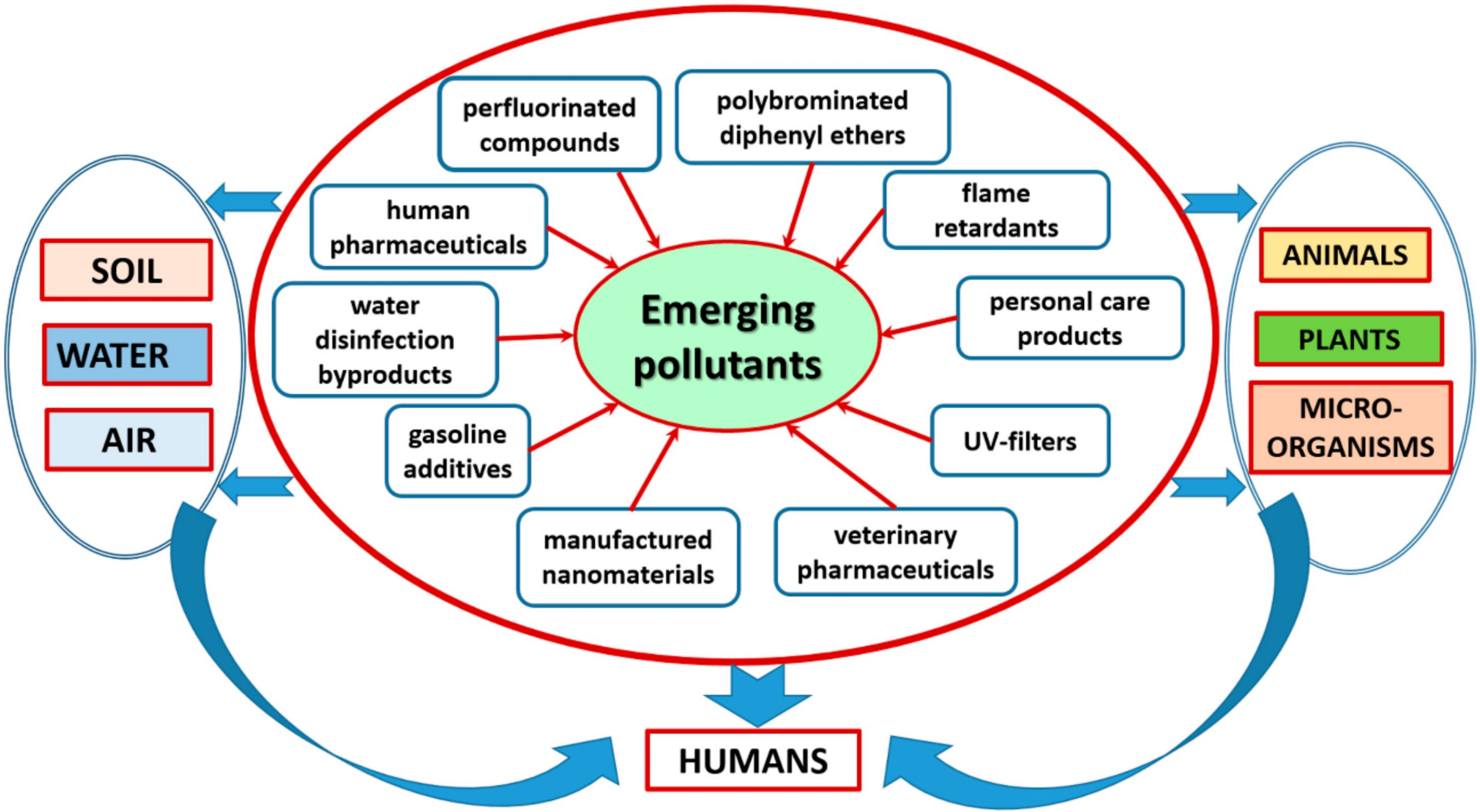


Chlorothalonil (fongicide)
probable carcinogen



Max conc. of the metabolite R471811 groundwater

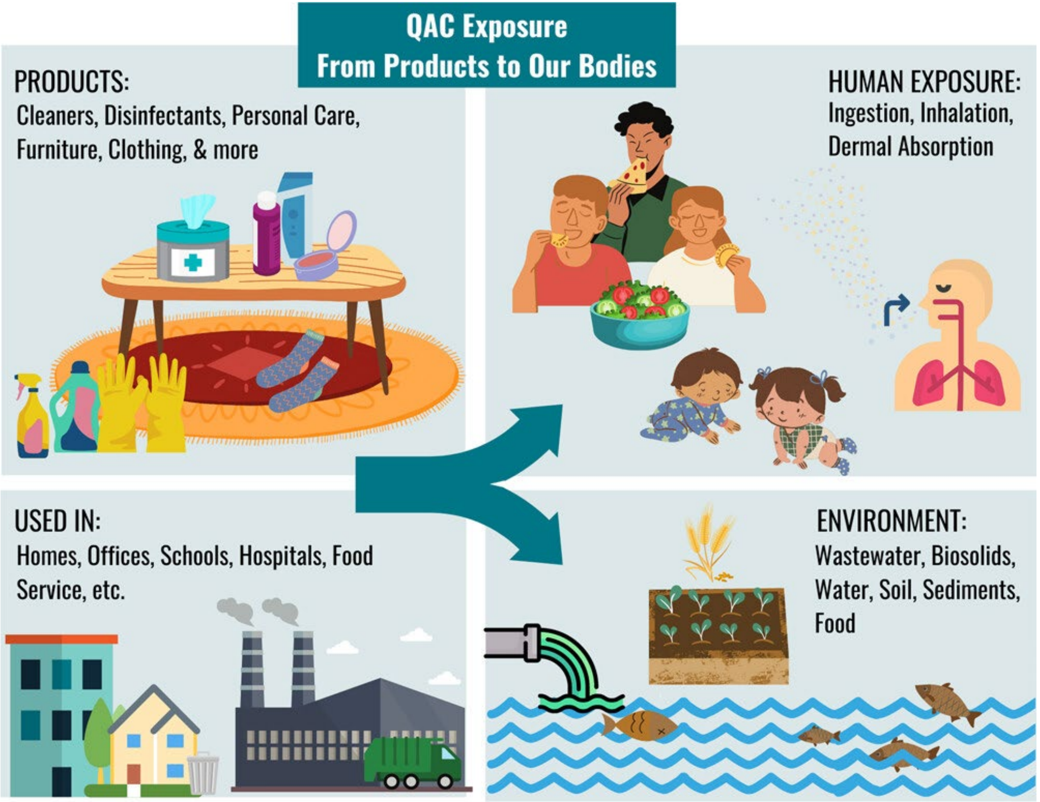
Emerging micropollutants

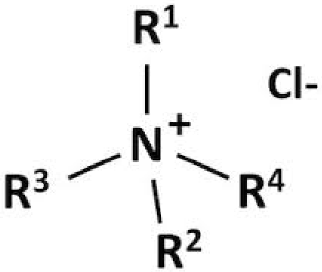


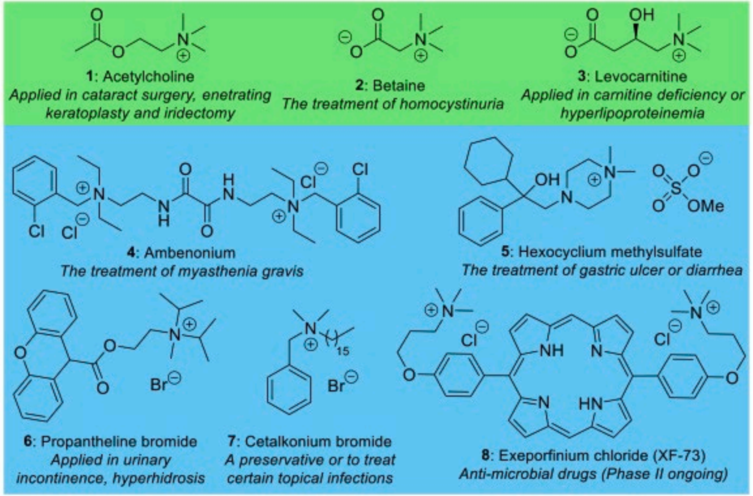
EPFL

Emerging micropollutants

Quaternary ammonium compounds (QACs)

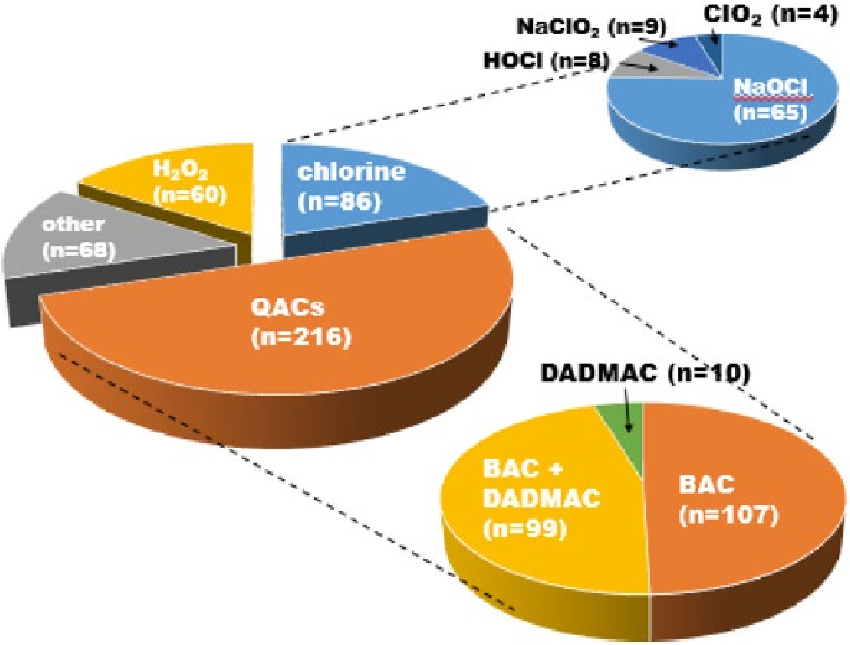






QAC exposure routes from products and other sources, via pathways indoors and outdoors.

Emerging micropollutants



Quaternary ammonium compounds (QACs)

pubs.acs.org/journal/estlcu

Review

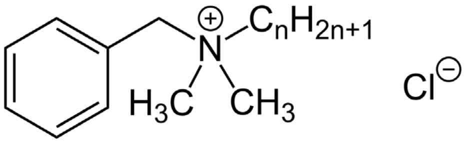
Increased Use of Quaternary Ammonium Compounds during the SARS-CoV-2 Pandemic and Beyond: Consideration of Environmental Implications

Priya I. Hora, Sarah G. Pati, Patrick J. McNamara, and William A. Arnold*

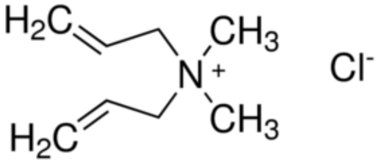
Cite This: *Environ. Sci. Technol. Lett.* 2020, 7, 622–631

Read Online

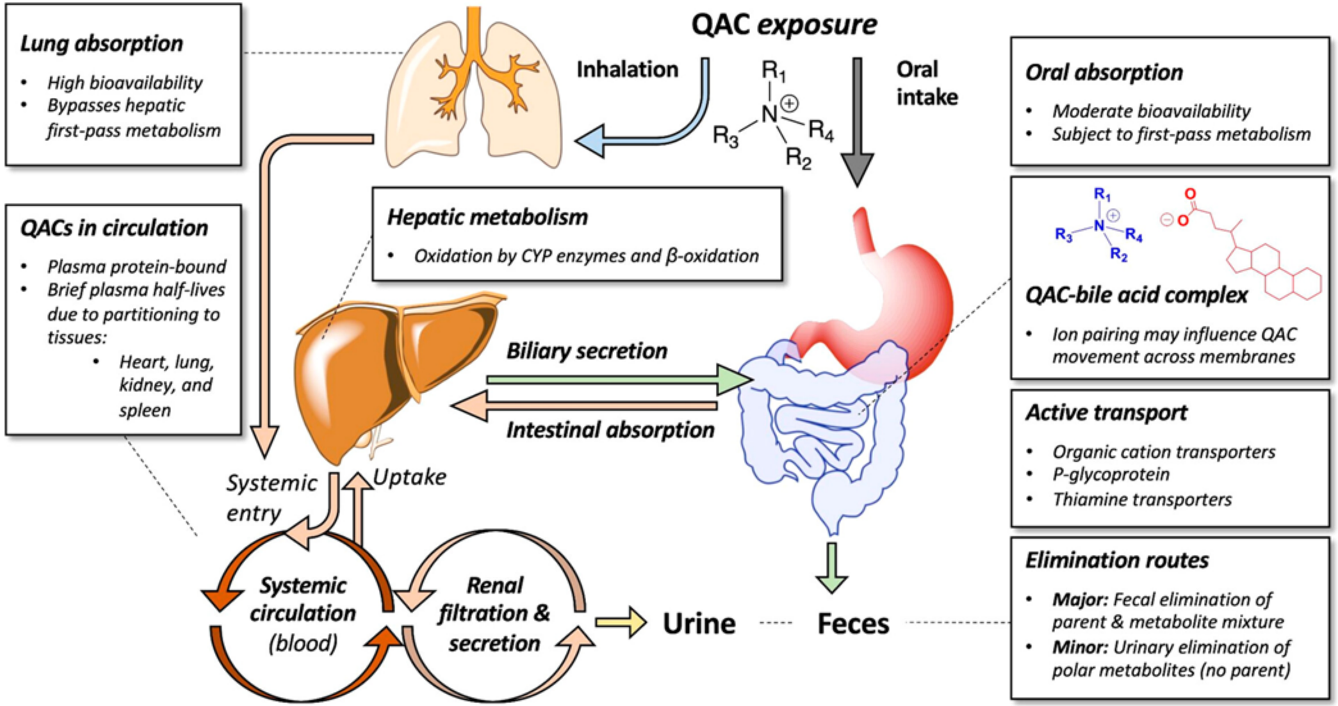
ABSTRACT: Quaternary ammonium compounds (QACs) are active ingredients in over 200 disinfectants currently recommended by the U.S. EPA for use to inactivate the SARS-CoV-2 (COVID-19) virus. The amounts of these compounds used in household, workplace, and industry settings has very likely increased, and usage will continue to be elevated given the scope of the pandemic. QACs have been previously detected in wastewater, surface waters, and sediments, and effects on antibiotic resistance have been explored. Thus, it is important to assess potential environmental and engineering impacts of elevated QAC usage, which may include disruption of wastewater treatment unit operations, proliferation of antibiotic resistance, formation of nitrosamine disinfection byproducts, and impacts on biota in surface waters. The threat caused by COVID-19 is clear, and a reasonable response is elevated use of QACs to mitigate spread of infection. Exploration of potential effects, environmental fate, and technologies to minimize environmental releases of QACs, however, is warranted.



n = 8, 10, 12, 14, 16, 18



Emerging micropollutants

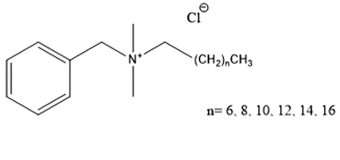


Proposed ADME routes for QACs based on in vitro and in vivo data on some subgroups of QACs in humans and animals.

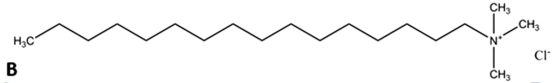
Emerging micropollutants

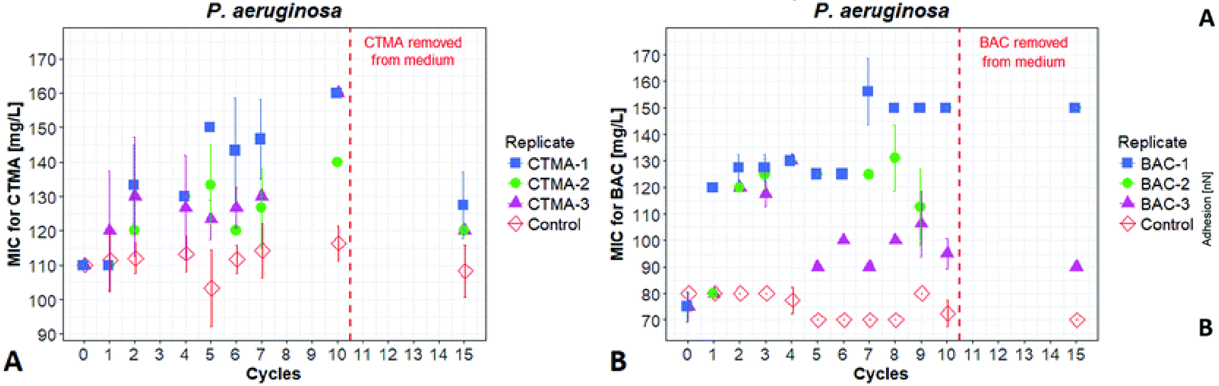
Development of bacterial resistance to QACs and antibiotics

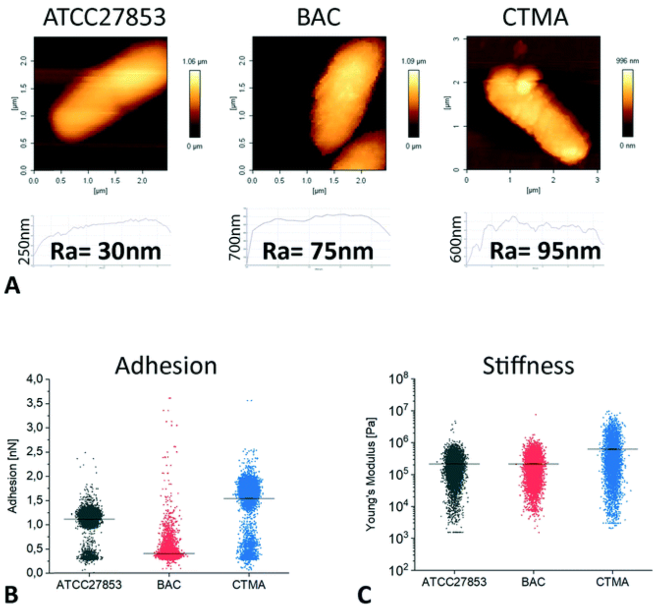
BAC



CTMA







A constant exposure to 88% of the minimum inhibitory concentration (MIC) of benzalkonium chloride (BAC) led to an increase of the MIC of P. aeruginosa

Voumard et al. 2020

EPFL

Emerging micropollutants

Environmental Science Processes & Impacts

ROYAL SOCIETY OF CHEMISTRY

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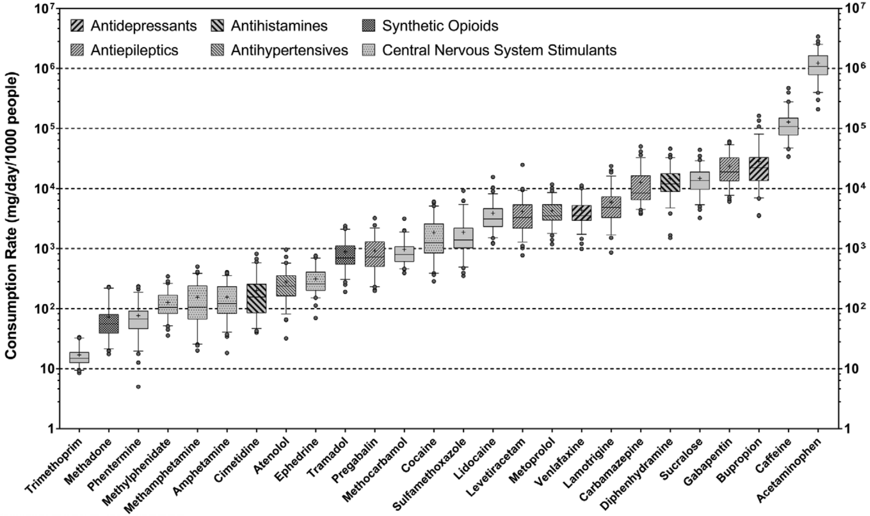
Received 28th August 2020
Accepted 14th October 2020

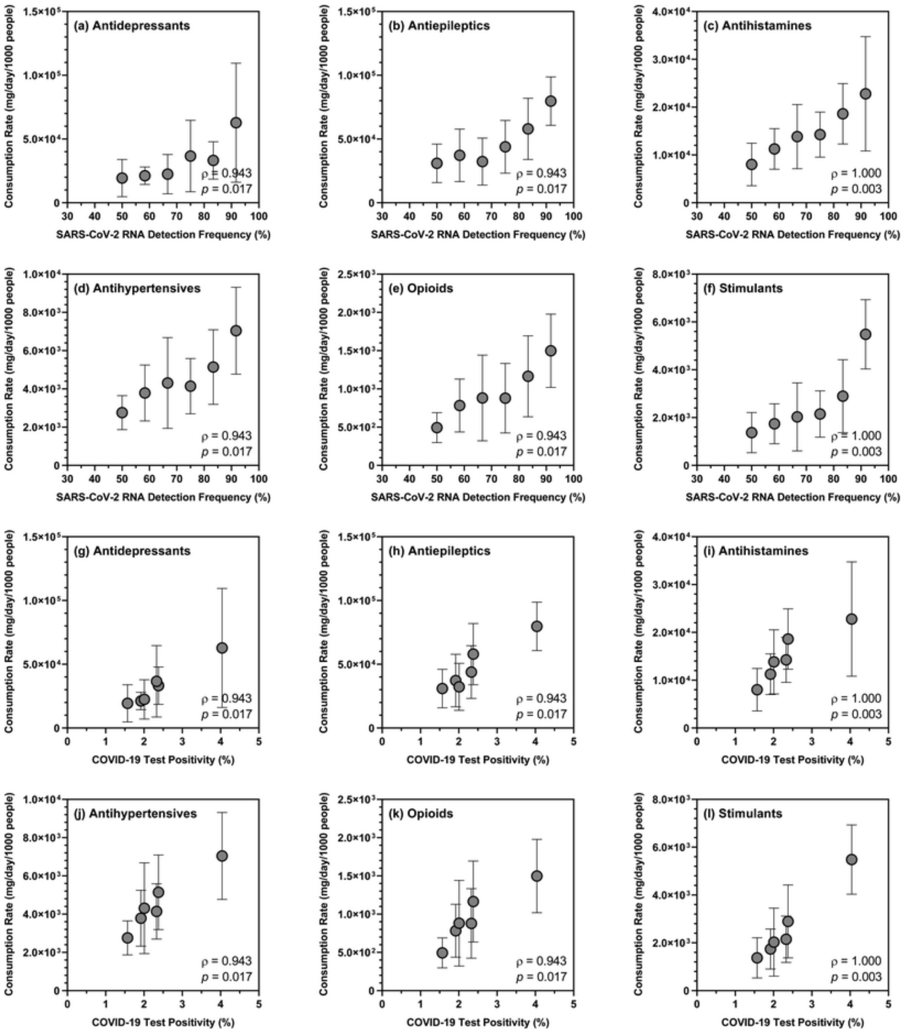
DOI: 10.1039/d0em00377h

rsc.li/espi

High-throughput wastewater analysis for substance use assessment in central New York during the COVID-19 pandemic

Shiru Wang,[a] Hyatt C. Green,[b] Maxwell L. Wilder,[b] Qian Du,[c] Brittany L. Kmush,[d] Mary B. Collins,[e] David A. Larsen[d] and Teng Zeng[*a]

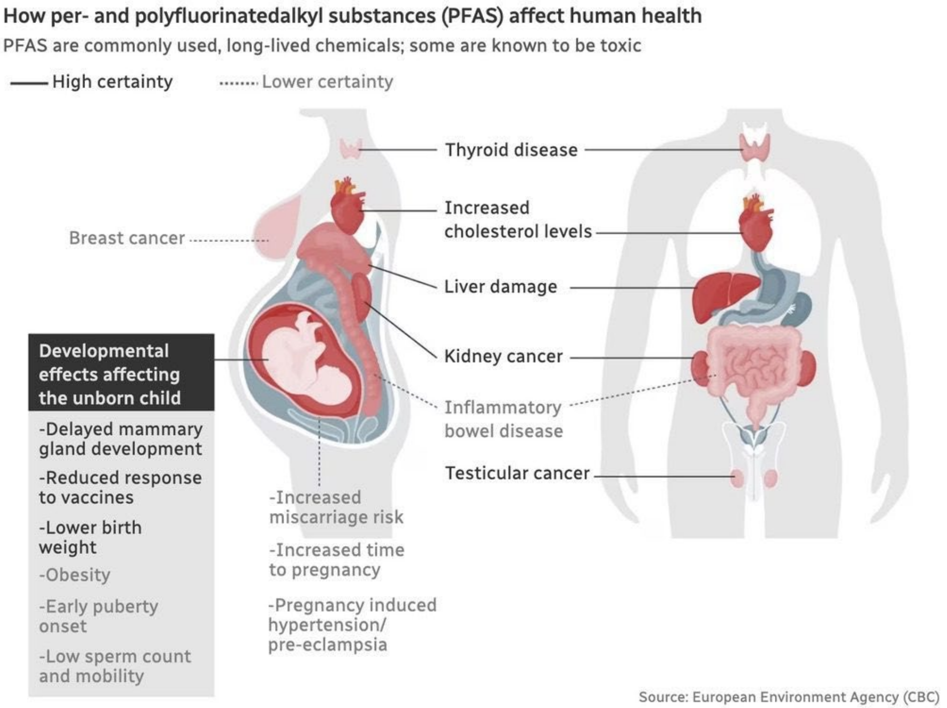


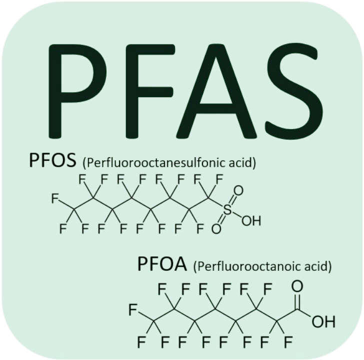


EPFL

Emerging micropollutants

Per- and polyfluoroalkyl substances (PFAS)



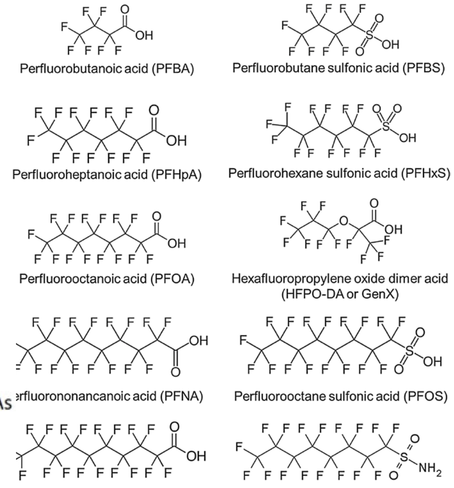


Emerging micropollutants

Per- and polyfluoroalkyl substances (PFAS)

- **Banks et al., 1994** — Perfluoro, Perfluorinated
- **Kyoto Protocol, 1997** — PFC's = Perfluorocarbons (C_nF_{2n+2})
- **Hekster and Voogt, 2002; Hekster et al., 2003** — Perfluoroalkylated Substances
- n = 982 — **OECD 2007** — Lists of PFOS, PFAS, PFOA, PFCA Related Compounds and Chemicals that Degrade to PFCAs
- **Buck, 2011**
- n = 4,730 — **OECD 2018** — PFAS: $-C_nF_{2n}-$ where n $\geq$ 3 and ($-C_nF_{2n}OC_mF_{2m}-$, n and m $\geq$ 1)
- **ITRC 2018** — PFAS: C_nF_{2n+1}-R where n > 2
- n = > 8,000 — **ECHA, 2020** — PFAS: all substances with $-CF_3$ or $-CF_2-$

Integr Envir Assess & Manag, Volume: 17, Issue: 5, Pages: 1045-1055, First published: 14 May 2021, DOI: (10.1002/ieam.4450)



Fluorocarbons, C-F Substances

Also, A Big Universe of Very Different Substances

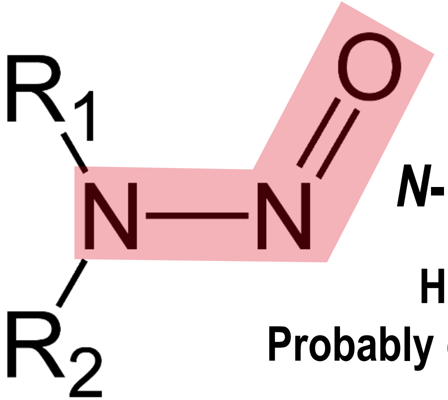
SOLID	LIQUID	GAS
 Polytetrafluoroethylene PTFE, $F(CF_2CF_2)_nF$ A Fluoropolymer	6:2 Fluorotelomer Alcohol $C_6F_{13}CH_2CH_2OH$	 HFC-134a CF_3CH_2F A Refrigerant

We should not group these together, because they are not the same.

Emerging micropollutants

International Agency Research on Cancer

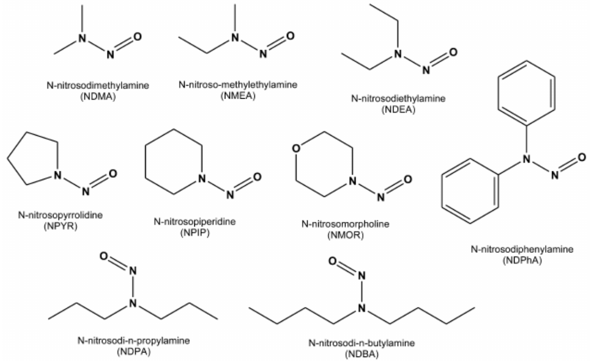
World Health Organization



***N*-nitrosamines**

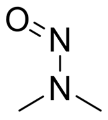
Highly mutagenic

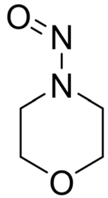
Probably carcinogenic to humans

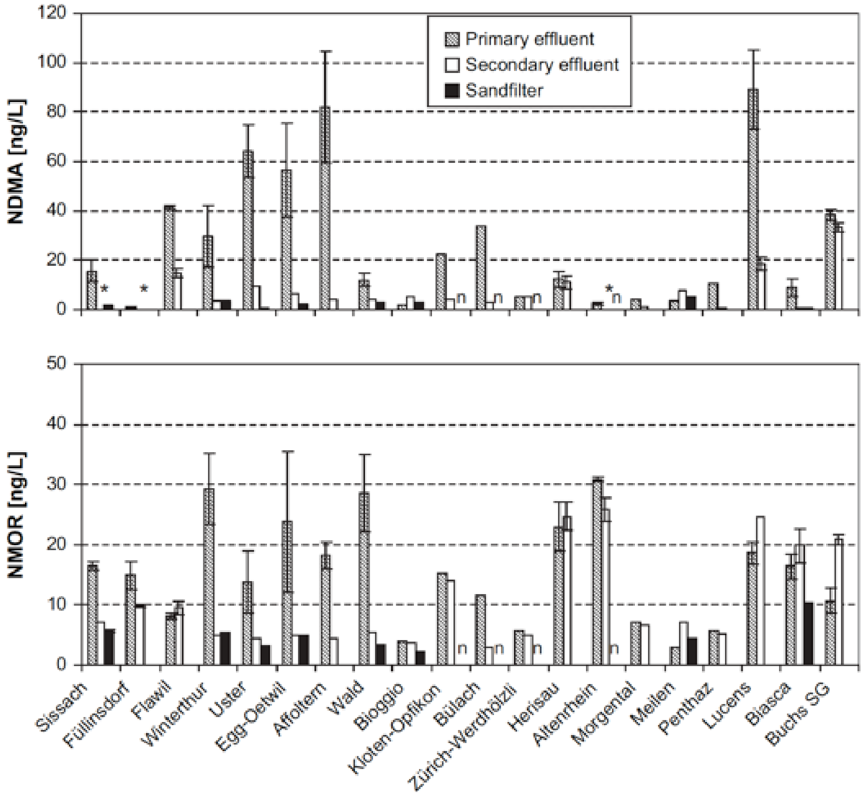


Emerging micropollutants

*N-nitrosamines in **municipal** wastewater*

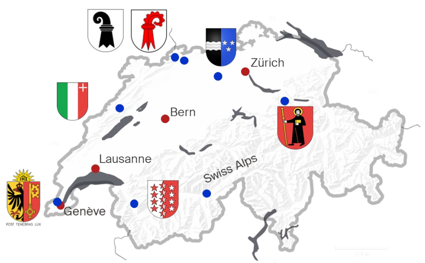


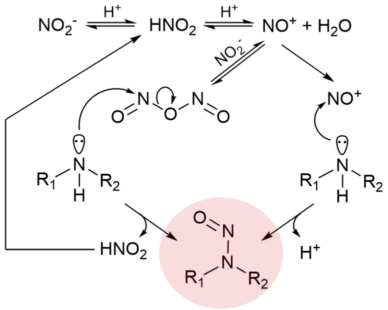


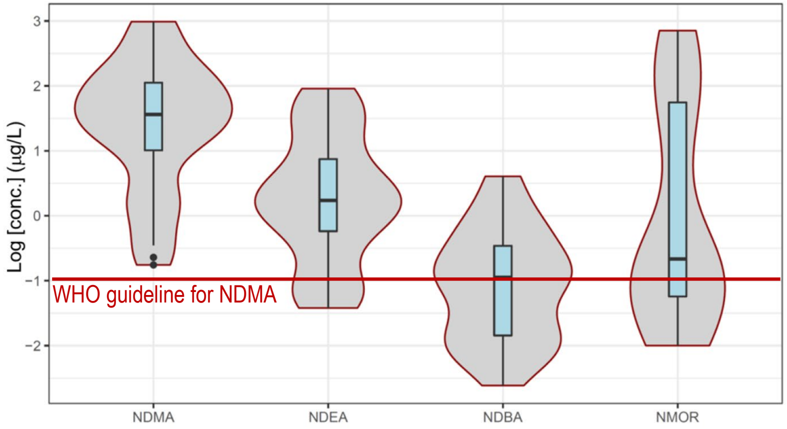


Krauss et al. Water Res. 2009

*N-nitrosamines in **industrial** wastewater*







Breider al. Water Res. 2023

Emerging micropollutants

Plastic Pollution

Macro/meso-plastics >5mm
Microplastics <5mm – 1μm
Nanoplastics <1μm – 1nm

Primary Microplastics
Primary microplastics are small pieces of plastic that are purposefully made.

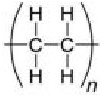
Secondary microplastics
Secondary plastics are small pieces of plastic derived from the decomposition of large pieces of plastic debris, both in water and on land.

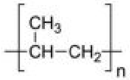
EPFL

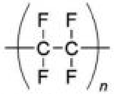
Emerging micropollutants

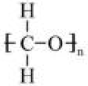
Plastic Pollution

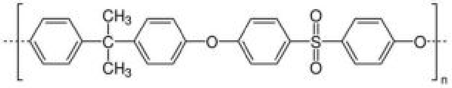
Different shapes, sizes, polymers (also copolymers), colors, additives, texture density...

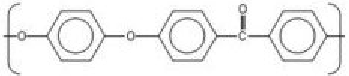

Polyethylene

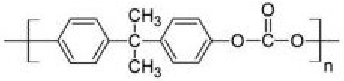

Polypropylene

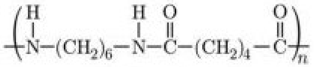

Polytetrafluoroethylene

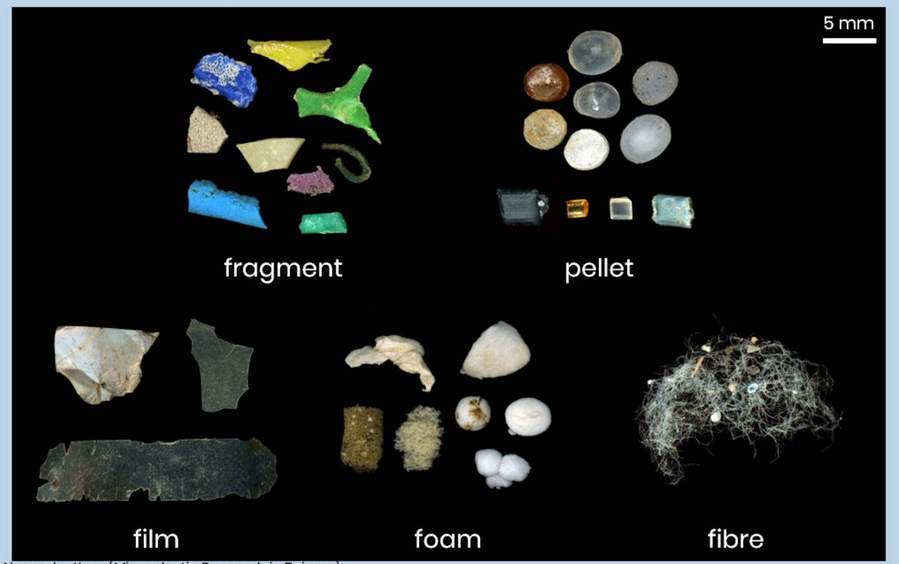

Polyacetal


Polysulfone


Poly(ether ether ketone)


Polycarbonate


Nylon 6/6



Alexander Kunz (Microplastic Research in Taiwan)

Emerging micropollutants

Plastic additives

Intentional additives

Added during manufacturing processes:
~10,550 chemicals possibly used.
(4,300 just for packaging)

Family: plasticizers, solvents, antioxidants, biocides, dyes, flame retardants, light stabilizers, fragrances, etc.

Provide additional properties to polymers (shape, longevity, color, gloss).

Little or no toxicological data and little regulation.

Unintentional contaminants

Degradation products or by-products during
Manufacturing processes

Environmental Science & Technology
pubs.acs.org/est
Article

Deep Dive into Plastic Monomers, Additives, and Processing Aids

Helene Wiesinger,* Zhanyun Wang,* and Stefanie Hellweg

Cite This: Environ. Sci. Technol. 2021, 55, 9339−9351
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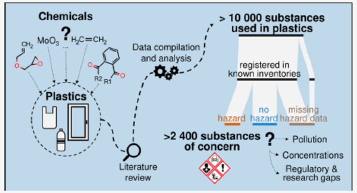
ABSTRACT: A variety of chemical substances used in plastic production may be released throughout the entire life cycle of the plastic, posing risks to human health, the environment, and recycling systems. Only a limited number of these substances have been widely studied. We systematically investigate plastic monomers, additives, and processing aids on the global market based on a review of 63 industrial, scientific, and regulatory data sources. In total, we identify more than 10'000 relevant substances and categorize them based on substance types, use patterns, and hazard classifications wherever possible. Over 2'400 substances are identified as substances of potential concern as they meet one or more of the persistence, bioaccumulation, and toxicity criteria in the European Union. Many of these substances are hardly studied according to SciFinder (266 substances), are not adequately regulated in many parts of the world (1'327 substances), or are even approved for use in food-contact plastics in some jurisdictions (901 substances). Substantial information gaps exist in the public ... t avoids the ... ibility.



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Review

Overview of known plastic packaging-associated chemicals and their hazards

Check for updates

Ksenia J. Groh [a],*, Thomas Backhaus [b], Bethanie Carney-Almroth [b], Birgit Geueke [a], Pedro A. Inostroza [b], Anna Lennquist [c], Heather A. Leslie [d], Maricel Maffini [e], Daniel Slunge [f], Leonardo Trasande [g], A. Michael Warhurst [h], Jane Muncke [a]

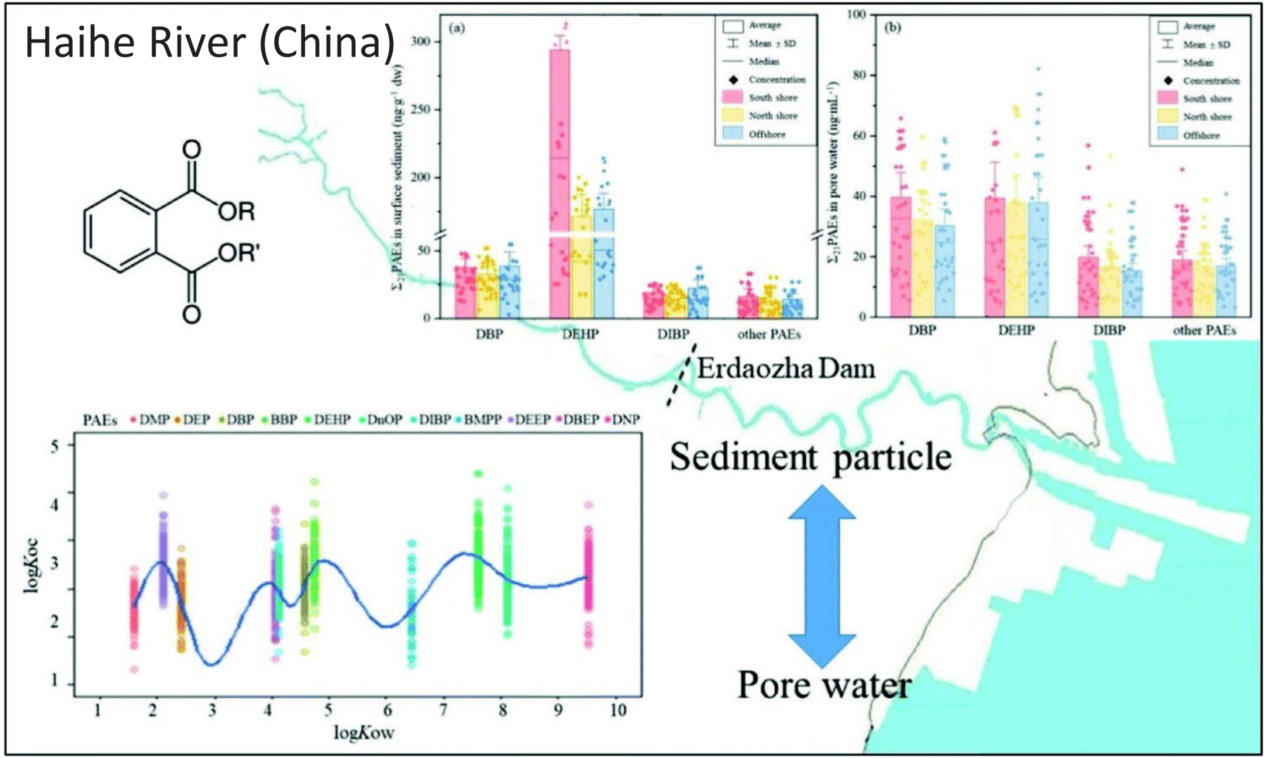
[a] Food Packaging Forum Foundation, Zurich, Switzerland
[b] Department of Biological and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden
[c] International Chemical Secretariat (ChemSec), Gothenburg, Sweden
[d] Department of Environment & Health, Vrije Universiteit Amsterdam, the Netherlands
[e] Independent Consultant, Germantown, MD, USA
[f] Centre for Sustainable Development (GMV), University of Gothenburg, Gothenburg, Sweden
[g] School of Medicine, New York University, New York, USA
[h] CHEM Trust, London, United Kingdom

EPFL

Emerging micropollutants

Plastic additives

Phthalate esters (PAEs) are a group of chemicals used to improve the flexibility and durability of plastics.



DEHP, DBP, and DIBP were the dominant species in surface sediment and pore water.

Notable differences in PAEs concentrations were observed between urban reaches and non-urban reaches.

Partitioning of PAEs between surface sediment and pore water was not significantly affected by K_{OW}.

Lui et al. (2020)

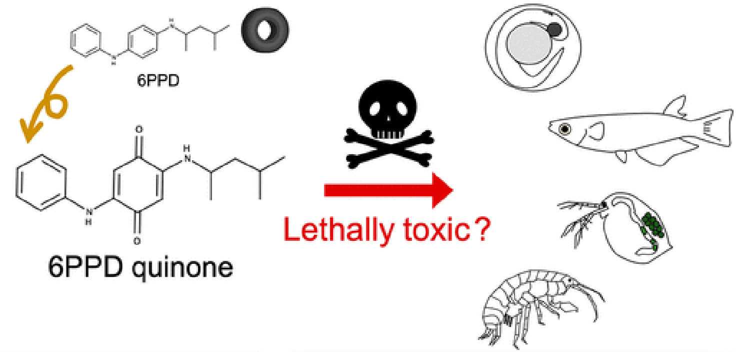
EPFL

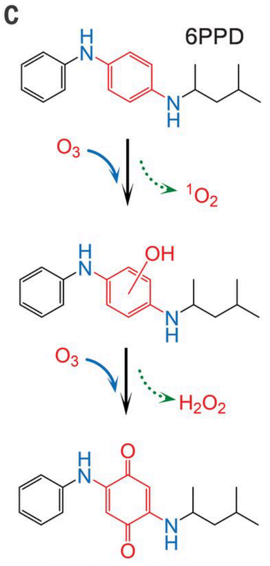
Emerging micropollutants

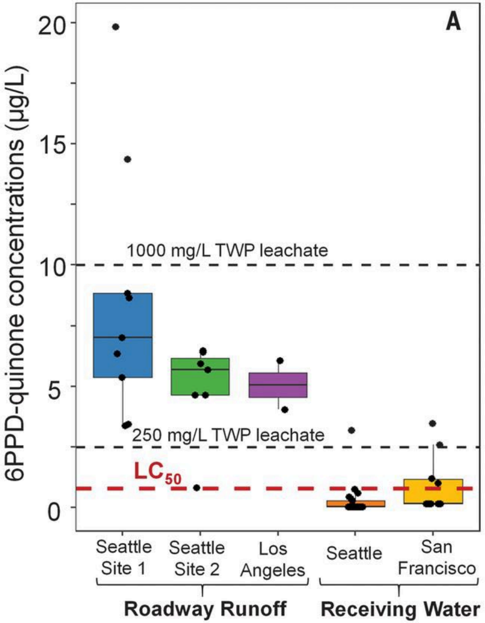
Rubber materials & Tire Particles

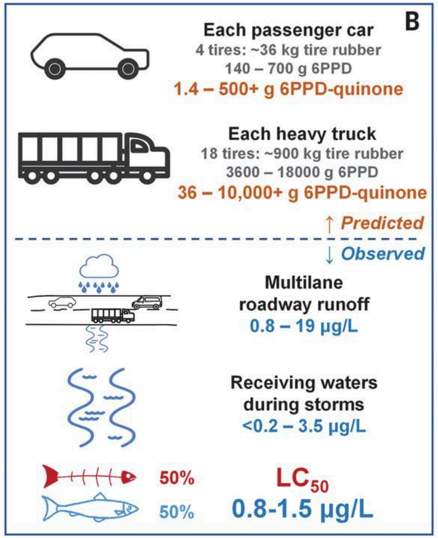
Tire and Road Wear Particles (TRWP)

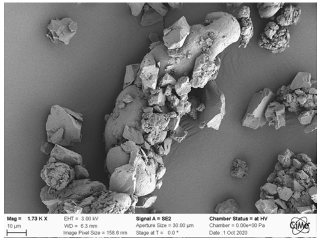
- PAHs, heavy metals, antioxidants,…





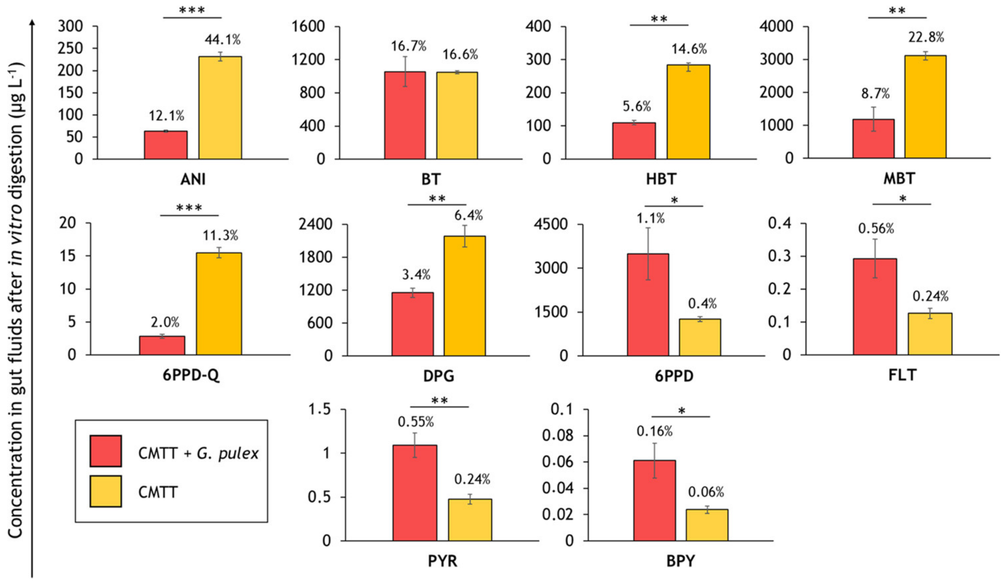


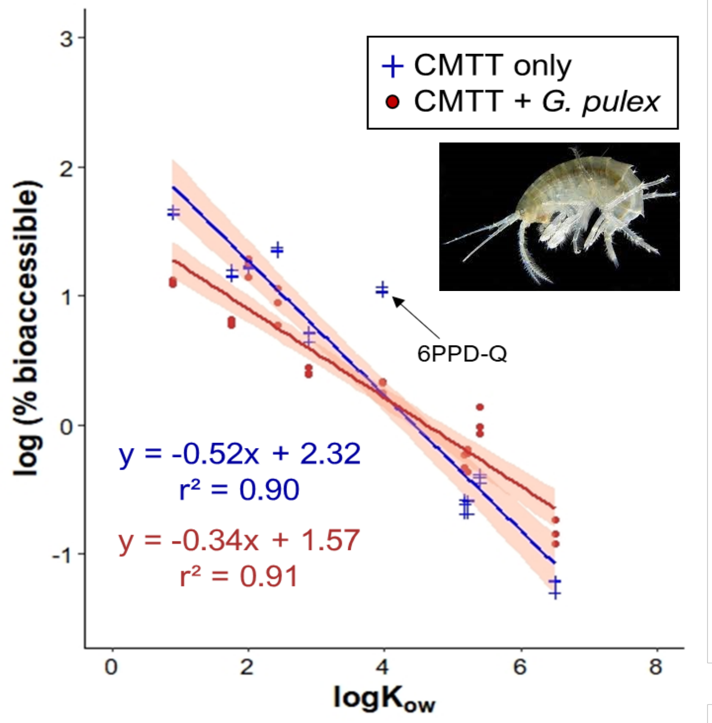




Emerging micropollutants

Rubber materials & Tire Particles





Masset et al. (2022)

International treaties and conventions on pollutants

International treaties and conventions

Stockholm Convention on Persistent Organic Pollutants

STOCKHOLM CONVENTION

Adopted on 22.05.2001, entered into force in May 2004, ratified by 150 countries in February 2008

Persistent organic pollutants (POPs) are organic compounds that are toxic and are not readily degradable.

The initial 12 POPs of the Stockholm Convention

Initially, twelve POPs were recognized as causing adverse effects on humans and the ecosystem.

Chemical	Pesticides	Industrial chemicals	By-products
Aldrin	+		
Chlordane	+		
DDT	+		
Dieldrin	+		
Endrin	+		
Heptachlor	+		
Mirex	+		
Toxaphene	+		
Hexachlorobenzene		+	+
Polychlorinated Biphenyls (PCBs)		+	+
Chlorinated Dioxins			+
Chlorinated Furans			+

EPFL

International treaties and conventions

Stockholm Convention on Persistent Organic Pollutants

STOCKHOLM CONVENTION

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Persistent organic pollutants (POPs) are organic compounds that are toxic and are not readily degradable.

Bans and restrictions on the manufacture and use of the following commercial products

Annex A: Elimination

- Aldrin
- Alpha-hexachlorocyclohexane
- Beta-hexachlorocyclohexane
- Chlordane
- Chlordecone
- ….

Annex B: Restriction

- DDT
- Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride

The unintentional production of the following substances, which for example may occur and be released in the course of incineration processes, should be minimised or eliminated wherever possible:

- Hexachlorobenzene
- Hexachlorobutadiene
- Pentachlorobenzene
- Polychlorinated biphenyls (PCBs)
- Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)
- Polychlorinated naphthalenes

International treaties and conventions

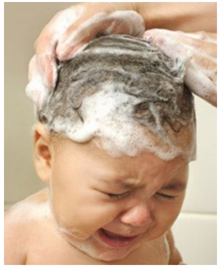
Stockholm Convention on Persistent Organic Pollutants

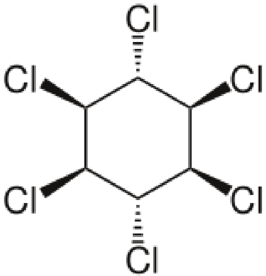
Adopted on 22.05.2001, entered into force in May 2004, ratified by 150 countries in February 2008

Persistent organic pollutants (POPs) are organic compounds that are toxic and are not readily degradable.

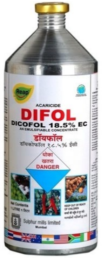
The new POPs of the Stockholm Convention

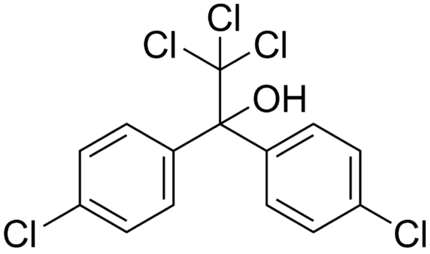
a-hexachlorocyclohexane, b-hexachlorocyclohexane, chlordecone, dicofol, lindane, PFOA, PFOS, polychlorinated naphthalenes, short-chain chlorinated parafins (SCCPs)...



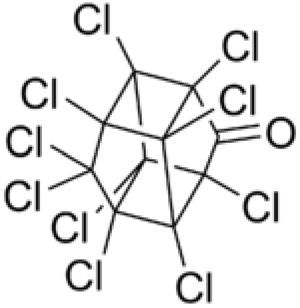


lindane





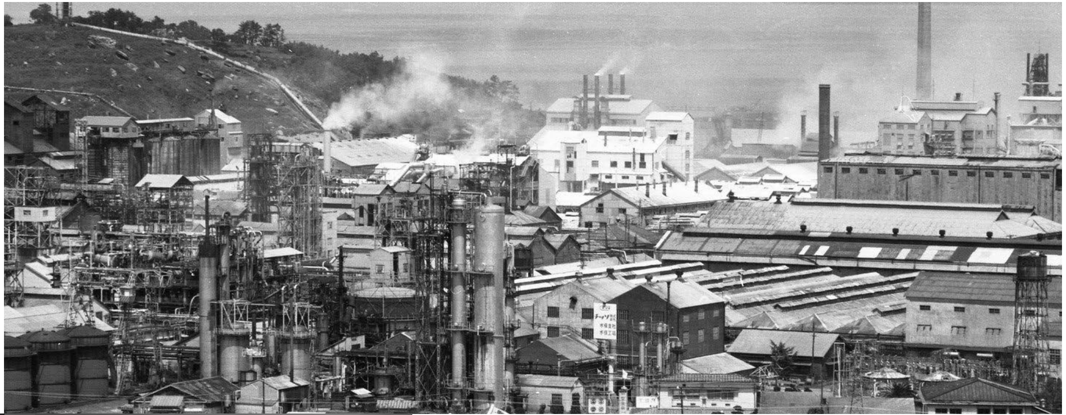
dicofol

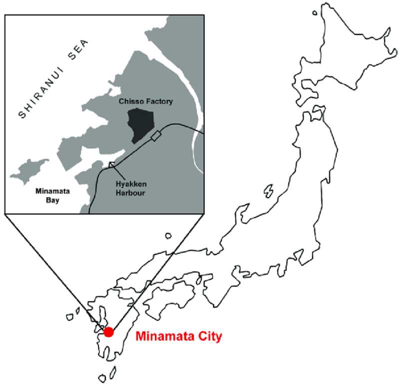


chlordecone

International treaties and conventions

MINAMATA CONVENTION ON MERCURY





Minamata disease was first discovered in the city of Minamata, (Japan) in 1956, hence its name. It was caused by the release of methylmercury in the industrial wastewater from a chemical factory owned by the Chisso Corporation, which continued from 1932 to 1968.

EPFL https://news.un.org/en/story/2021/10/1103842

International treaties and conventions

MINAMATA
CONVENTION
ON MERCURY

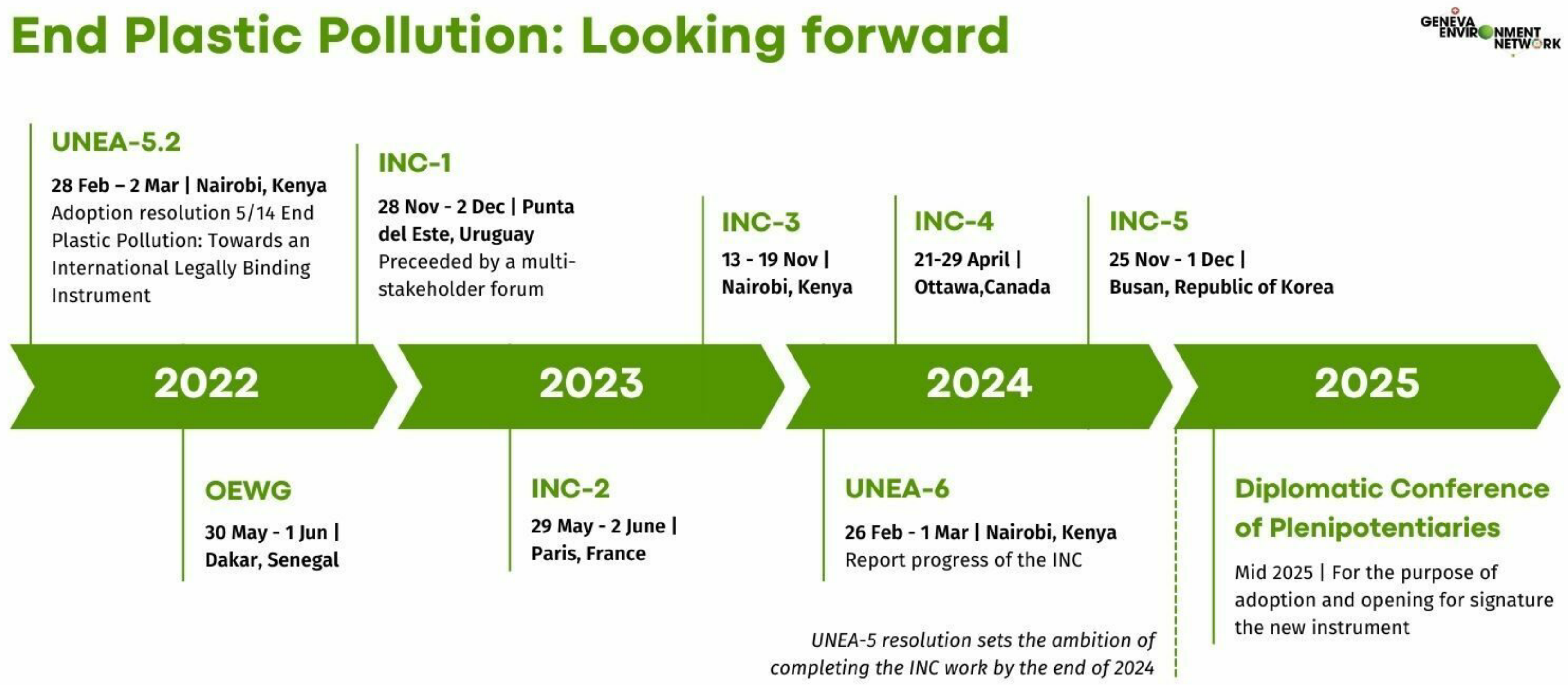
Operational provisions describing the obligations for Parties to reduce anthropogenic emissions and **releases of mercury and mercury compounds** to the environment, with controls on all their lifecycle stages:

- Controls on mercury supply sources and trade (Article 3)
- Phase-out and phase-down of mercury use in products and processes (Articles 4, 5 and 6, Annexes A and B)
- Controls on artisanal and small scale gold mining where mercury is used (Article 7, Annex C)
- Controls on air emissions and releases to land and water (Articles 8 and 9, Annex D)
- Storage, waste and contaminated sites (Articles 10, 11 and 12)

https://news.un.org/en/story/2021/10/1103842

International treaties and conventions

UN Global Plastics Treaty



International treaties and conventions

UN Global Plastics Treaty

Some key points the treaty may include are:

• Determining where the life cycle of plastic production begins, and potentially capping primary plastic polymer production.

• The "Zero Draft" of the plastics treaty aims to promote better the sustainable production of plastics for packaging through product design and environmentally sound waste management

• The treaty may aim to advance national and international cooperative plastic reduction measures aimed at pollution in marine environments.

•Specifying national reporting to the INC, when appropriate, and assessing the progress and effectiveness of the agreement.

•Initiating a multi-stakeholder action agenda, including the private sector, to promote cooperation at the local, national, regional and global levels.

•The treaty may aim to specify arrangements for capacity-building and technical assistance, mutually agreed technology transfer terms and financial assistance.

These are key points that may not be in the finalized treaty, however, are areas of interest in the negotiation process.


Thank you for your attention