Jacobi
GROUP

Persistent contaminants (including PFAS) removal with Activated Carbon and Ion Exchange Resins technologies ; For water, soil and sediment remediation

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HUMAN ACTIVITY HAS LEAD TO THE CONTAMINATION OF THE ENVIRONMENT

Industrial wasteland

Industrial surface run-off

Firefigthing excercises

Spills

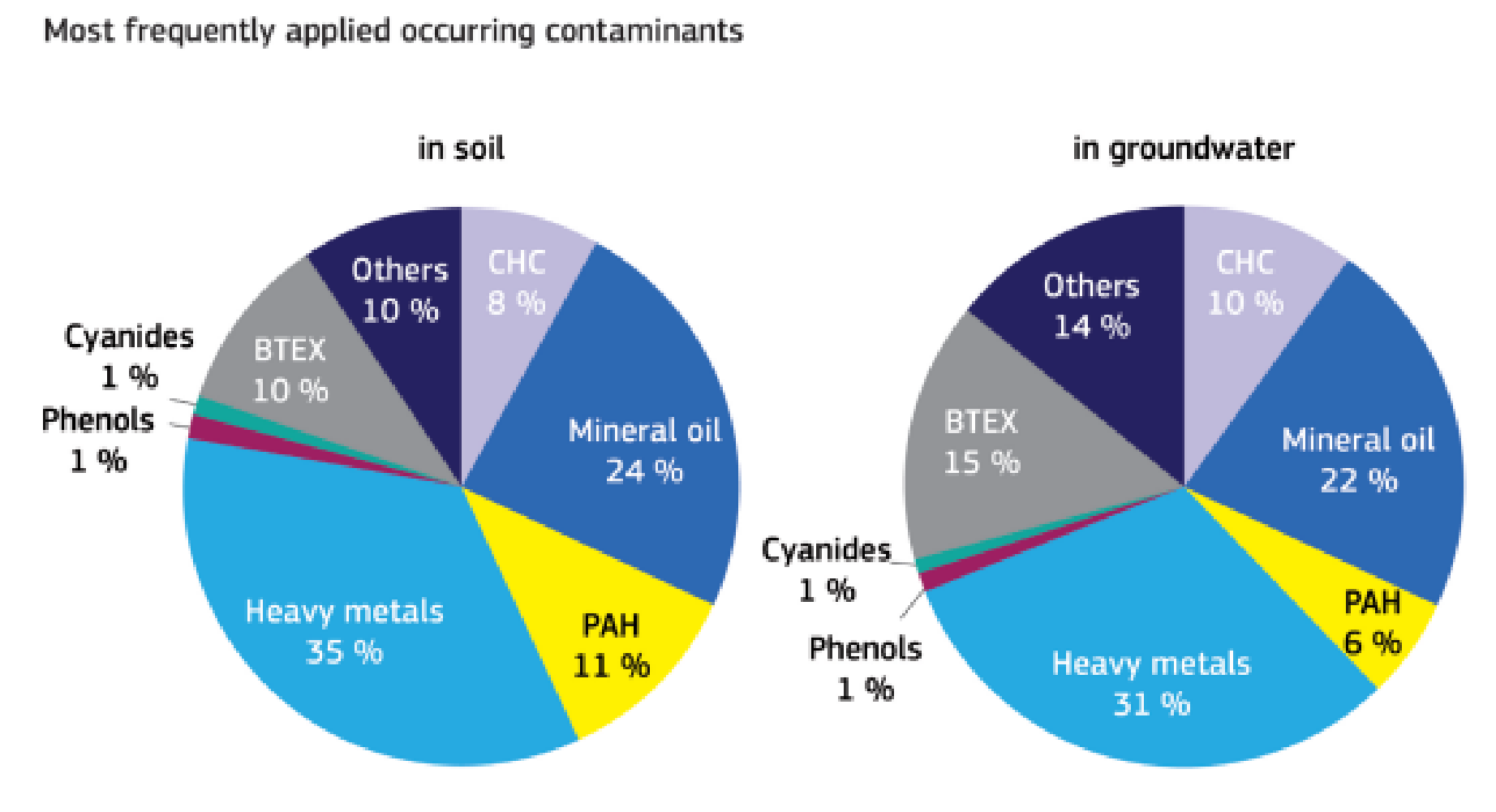
Fume deposits

Leaks in gas stations

CONSEQUENCES OF CONTAMINATION

- Restricted access zones → Population displacement
- Food chain contamination → Restrictions on local food
- Contamination of water sources
- Reduction of soil fertility → risk on food security
- Health concerns: cancer, nervous system damage, cardiovascular diseases, breathing disorders, birth defects, skin defects, chronic kidney diseases, immune system disorders, premature mortality, etc…
- Propagation of antimicrobial resistance genes in soil microorganisms → health risks

MOST FREQUENTLY OCCURING CONTAMINANTS



Source : European Commission. Joint Research Centre. Progress in the management of Contaminated Sites in Europe. Marc van Liedekerke, Gundula Prokop, Sabine Rabl-Berger, Mark Kibblewhite, Geertrui Louwagie. 2014

ACTIVATED CARBON FOR REMEDIATION

A **100% natural** product

With a **high surface area** per unit mass (>1000 m^2/g)

A versatile **adsorbent** for gas & liquid streams

Used in hundreds of **purification** applications, incl. remediation (pump&treat, thermal desorption, stripping, SVE, etc...)

- Volatile Organic Compounds
- Volatile aliphatic hydrocarbons
- Volatile Chlorinated Hydrocarbons
- BTEX
- MTBE
- H_2S
- Dioxins
- Mercury

- VOCs, VAH, VCH, BTEX, MTBE as above
- Mineral Oil Hydrocarbons
- Total Petroleum Hydrocarbons
- Chlorinated compounds
- Pesticides
- PAH
- Diesel
- Fuel
- PFAS
- Cyanide
- Mercury
- H_2S
- Ammonia

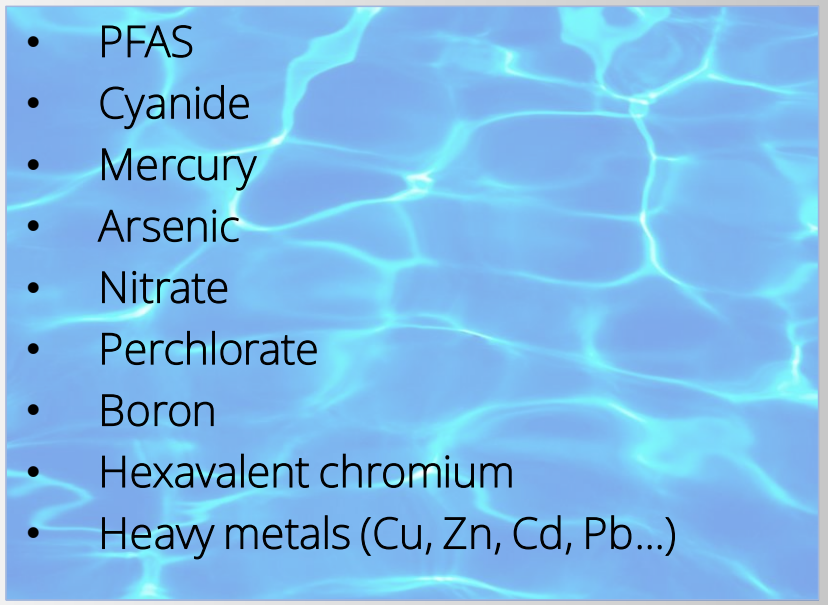
ION EXCHANGE RESINS FOR REMEDIATION

Selective removal
of microcontaminants

Very **high loading** capacity

In-situ **regenerable**
easy chemical regeneration

By **capturing** undesirable **ionic species**, resins are a complementary medium to activated carbon.



- PFAS
- Cyanide
- Mercury
- Arsenic
- Nitrate
- Perchlorate
- Boron
- Hexavalent chromium
- Heavy metals (Cu, Zn, Cd, Pb…)

SUCCESS STORY #1 : FJORD REMEDIATION

- Challenge: Pollution of sediments in the Fjords due to industry and shipping activities, transferred via the food chain : PAH, TBT, dioxins and furans, PCB, DDT and heavy metals
- Process: Capping of sediments
- Solution: Sustainable powder activated carbon made from renewable raw material: AquaSorb™ CP
- Lifetime: Definitive treatment

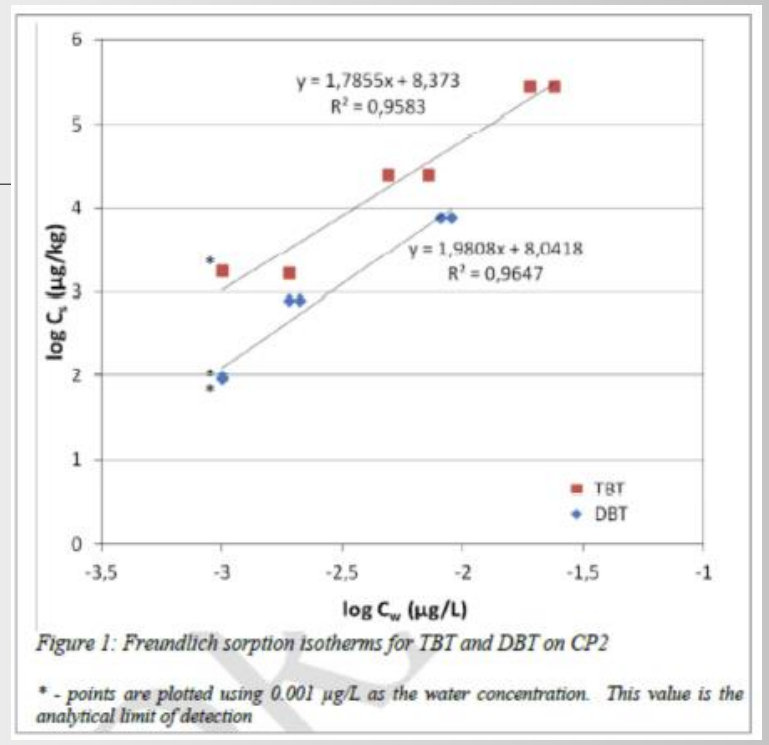


Figure 1: Freundlich sorption isotherms for TBT and DBT on CP2

** - points are plotted using 0.001 µg/L as the water concentration. This value is the analytical limit of detection*

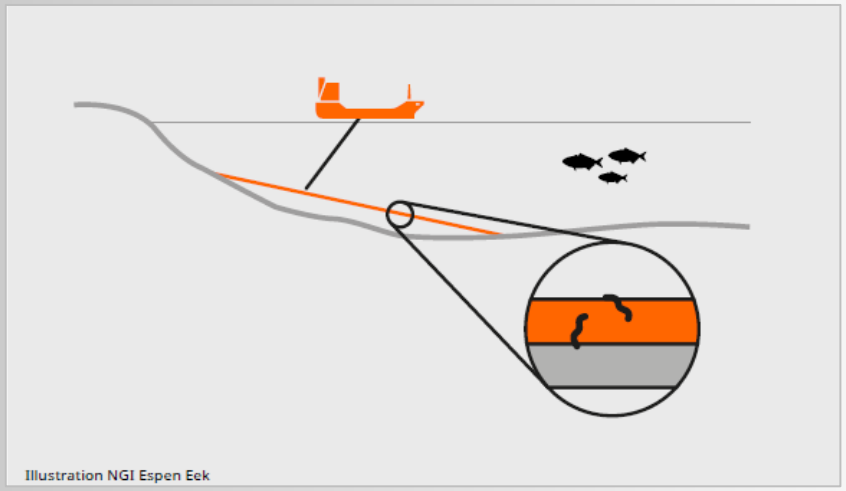
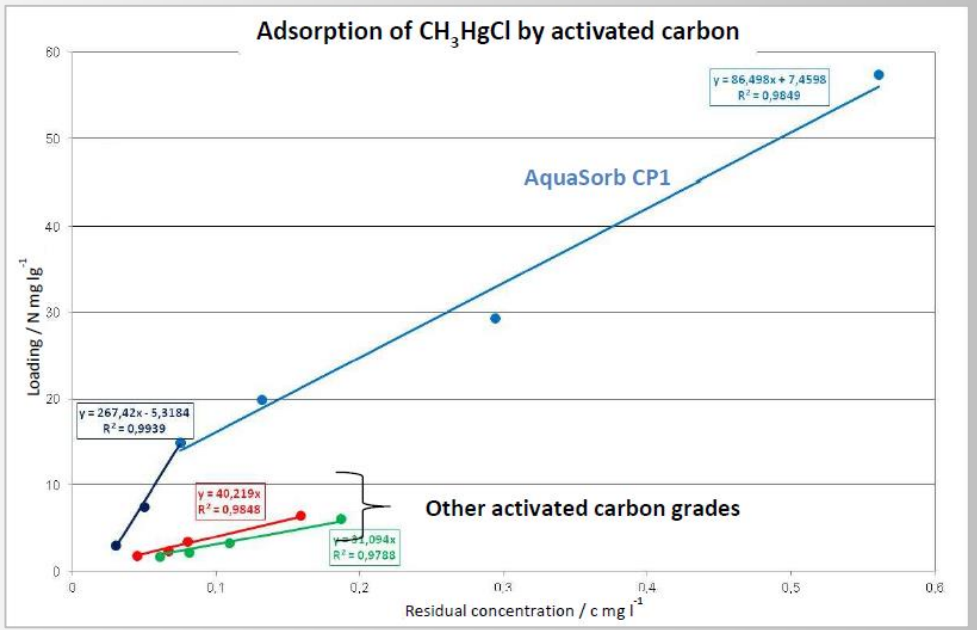


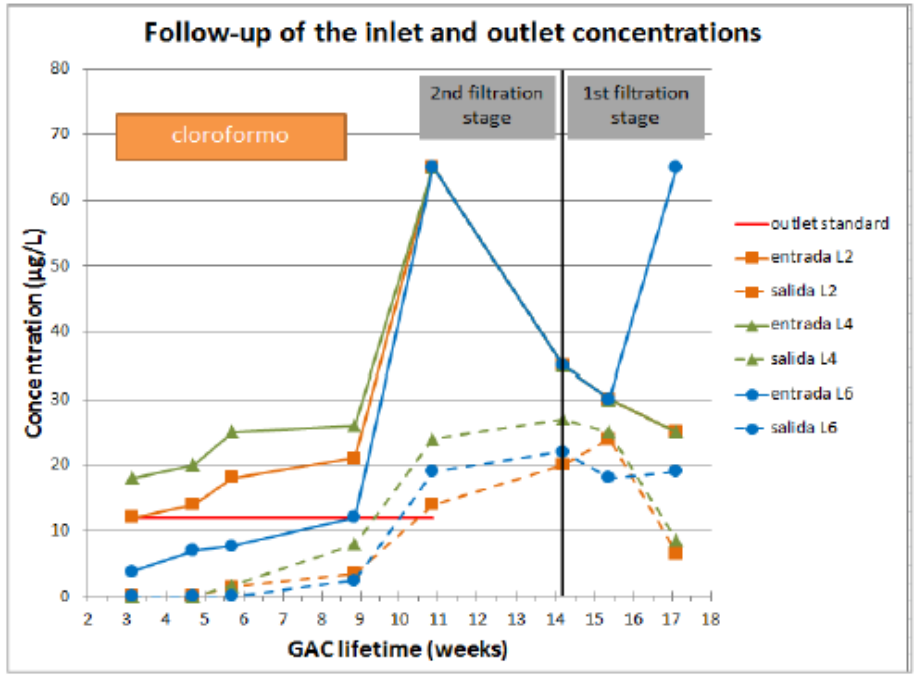
Illustration NGI Espen Eek



SUCCESS STORY #2 : RIVER REMEDIATION

- Challenge: River contamination by chemicals from former industries (discharging wastewater into the river)
- Process: River lagoon → separation of hydrocarbons by flotation → coagulation-flocculation → sand filtration → GAC filtration (1st step) → GAC filtration (2nd step) → storage of water before discharge into the river
- Solution:
  - Flow = 50 m^3/h/line
  - 6 lines in parallel x 2 filters in series
  - AquaSorb™ CS in AquaFlow™ V20H
- Lifetime: Replacement every 10 weeks

Parámetro	Límite	unit
Cadmio	5	µg/L
Mercurio	1	µg/L
Hexaclorobenceno	30	ng/L
Hexaclorocyclohexano (suma)	100	ng/L
DDT	25 000	ng/L
Tetracloroetileno	10	µg/L
Tetracloruro de Carbono	12	µg/L
Cloroformo	12	µg/L
Hexaclorobutadieno	0,1	µg/L
Tricloroetileno	10	µg/L



SUCCESS STORY #3 : SOIL REMEDIATION

- Challenge : Mercury/zinc/VHOC contaminated soil of a brand new middle school
- Process : Excavation of soil → Soil heated to 350°C
- Solution:
  - WATER. Flow = 67 m^3/h * 4

    4 lines in parallel x 3 filters in series

    GAC → ReSorb (22m^3/f) → Resinex CH-23 (3,5 m^3/f) for zinc removal

    8 AquaFlow V20H
  - AIR (Mercury vapor @ 5-10°C). Flow = 700 m^3/h

    2 lines in parallel x 2 filters in series

    ReSorb (2 m^3/f) → AddSorb VQ1 (2 m^3/f)

    4 EcoFlow C2
  - CONDENSATE @ 5-10°C. Flow = 5 m^3/h

    3 filters in series

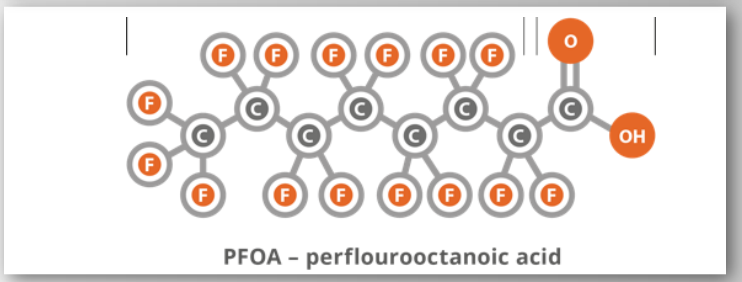
    ReSorb (2 m^3) → VQ1 (2 m^3) → CH-80 (2 m^3) for mercury

    3 AquaFlow LM2000
- Duration: Initially : 3-6 months → Reality = 3 years!

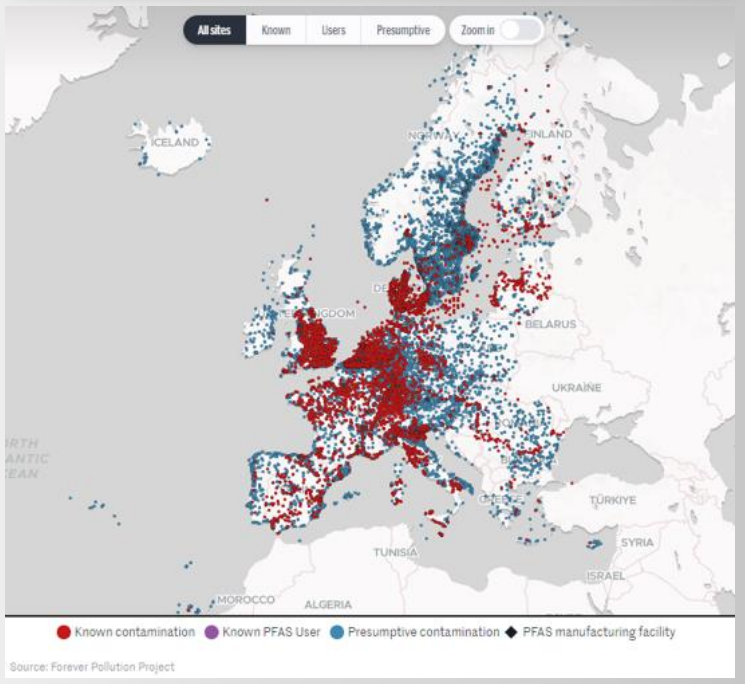
POLY- AND PERFLUOROALKYL SUBSTANCES (PFAS) CHALLENGE

- Manmade chemical compounds
- Since 1950s
- Carbon chains with fluorine atoms attached
- Large number of compounds (~10 000)
- Most common: PFOA, PFOS, PFNA, PFBS, PFHxA…
- FOREVER CHEMICALS: persistent (POP), bio-accumulative, mobile and toxic
- All around us: food (packaging), cosmetics, consumer goods, fire fighting foam…

The C-F bond is one of the shortest and strongest in nature



PFOA – perflourooctanoic acid



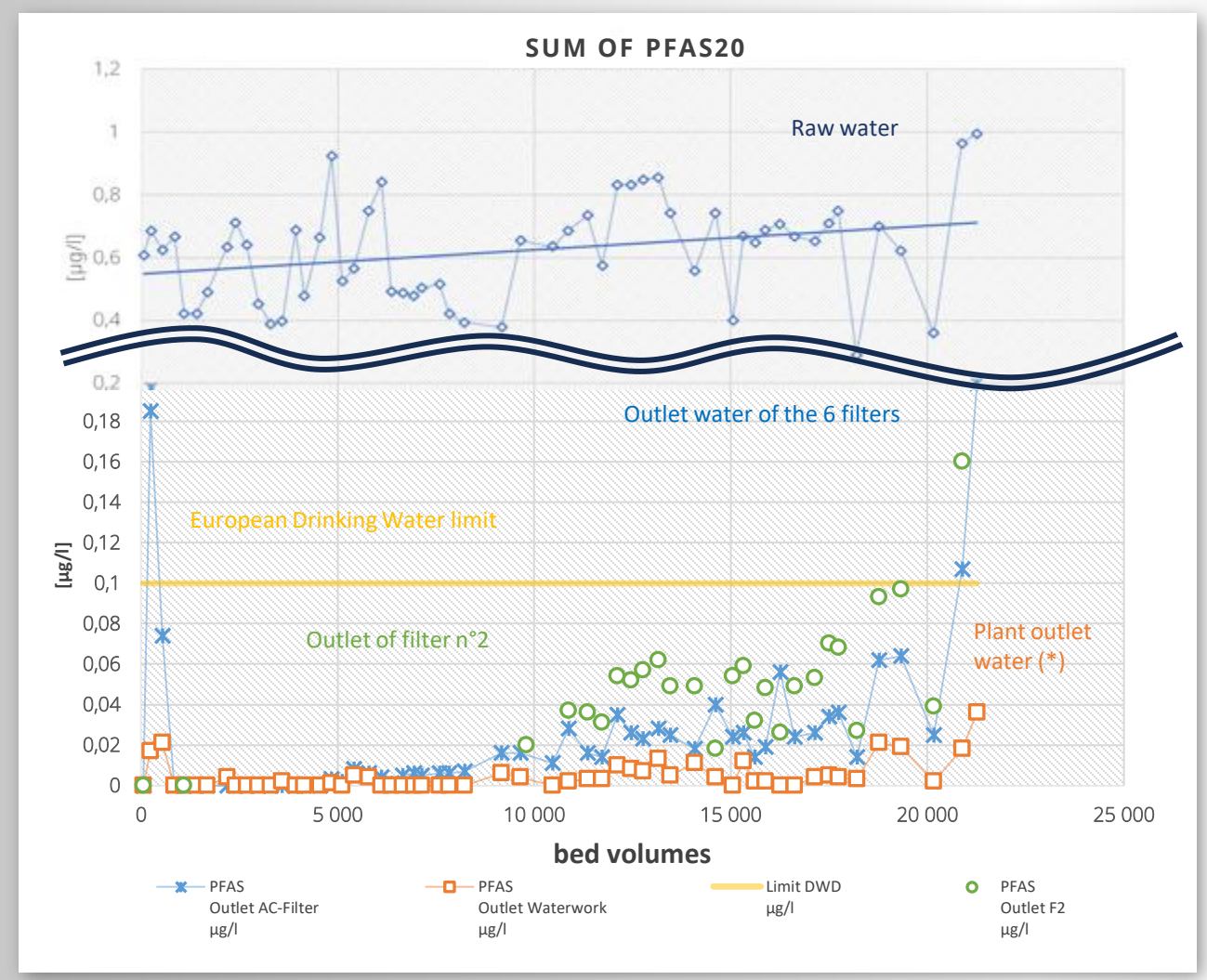
SOURCE : HTTPS://WWW.LEMONDE.FR/EN/LES-DECODEURS/ARTICLE/2023/02/23/FOREVER-POLLUTION-EXPLORE-THE-MAP-OF-EUROPE-S-PFAS-CONTAMINATION_6016905_8.HTML

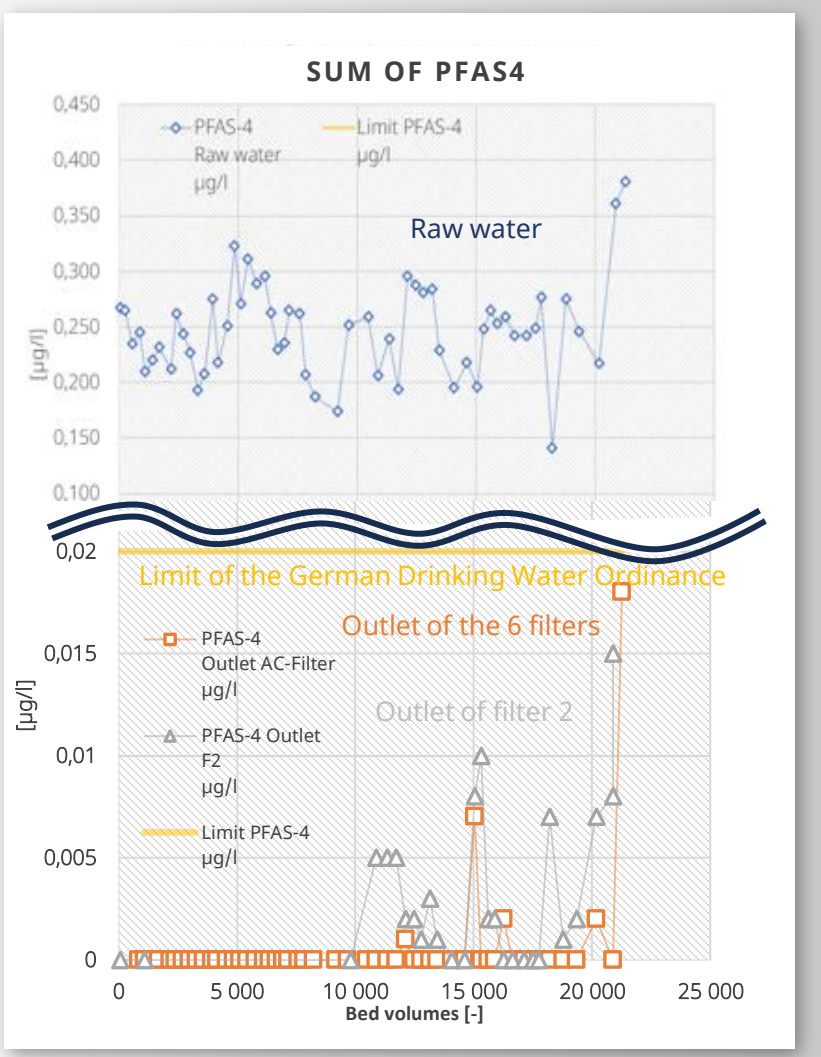
SUCCESS STORY #4 : GROUNDWATER REMEDIATION (1/2)

- Challenge: PFAS contamination of groundwater (intended to drinking water production) due to fire figthing exercices at the nearby airport:
  - PFAS20 = 500-700 ng/L
  - PFAS4 = 200-300 ng/L
- Target:
  - PFAS20 < 100 ng/L (European drinking water standard)
  - PFAS4 < 20 ng/L
- Process: Wells → activated carbon
- Solution:
  - 6 filters AquaFlow™ V20H in parallel x 60 m^3/h filled with AquaSorb™ 6300
  - Safe reactivation : Official extension of Jacobi-Germany permit for the reactivation of PFAS loaded GAC used for drinking water production (after an extensive trial in coordination with the authorities)
- Lifetime: up to 20 000 BV

Pic.: Aachener Zeitung, 12.4.2023

SUCCESS STORY #4 : GROUNDWATER REMEDIATION 2/2





JACOBI'S OFFER FOR REMEDIATION

The supply chain for adsorption in remediation

- Activated Carbons:
  - ✓ Organic contaminant removal (liquid phase/gas phase)
- Resinex:
  - ✓ Heavy metals removal
- Other media : arsenic removal…
- Mobile Filtration Units:
  - ✓ Air or effluent treatment
  - ✓ Rental units for temporary treatment or emergency units
- Services :
  - ✓ Safe reactivation
  - ✓ Recycling capacity
  - ✓ Compliant disposal options
- Technical expertise
- Solutions compatible with Sustainable Development

Sparks - Jacobi Carbons' local partner in Norway

- 3 x 30 years of experience with materials to the process industry.
- Market leader in Norway for activated carbon.
- Friendly, efficient and local follow-up.
- www.sparks.as