

PHOENIX*

*PFAS Historical Origin Evaluation on
Industrial textile Spreading Sludge*

STUDY OF ORIGIN OF PFAS POLLUTION IN SOIL AND WATER

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01**Context****02****Study area & Campaign****Historic Drinking Water* PFAS data (*DW)****03****Analytical methods selected for study****04****Results****4.1 /4.2 PFAS targets SOILS - SLUDGES****4.3 PFAS profile : TOP assay results****4.4 PFAS profile in Drinking Water****4.5 TFA focus****05**

- **Outcome of the study : results**
- **Provide first feedback on regulation**



➤ Findings :

- PFAS contamination* detected in raw water source of many rural towns. * *Results from ARS*
- Industrial sludge spreading identified on agricultural land close to water catchment

➤ Regulation monitoring :

- Decree of 22/12/2025 – DW = 22 PFAS (20 + 6:2 FTSA + TFA)
- AM 03/09/2025 + up-dated version of 20/04/2026 : 22 (6:2 FTSA+ 6:2 FTAB) + TFA in wastewater
- Sludge circular of 27/04/2026 : sludge of urban and industrial wastewater treatment plants are monitored for PFAS (List of 50 +2 PFAS (6:2 FTAB +TFA))

➤ Objectives :

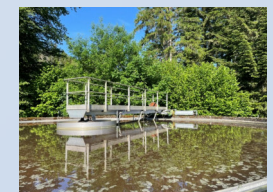
- Identify the origin of PFAS contamination in DW ➔ Analysis of selected soils enriched with industrial sludges
- Search for PFAS markers of the contamination source
- Evaluate suitability of first regulations

02-1 Study perimeter

➤ Sites :



Sampling locations were distributed across the north of the textile industrial sites located in Vosges (88)



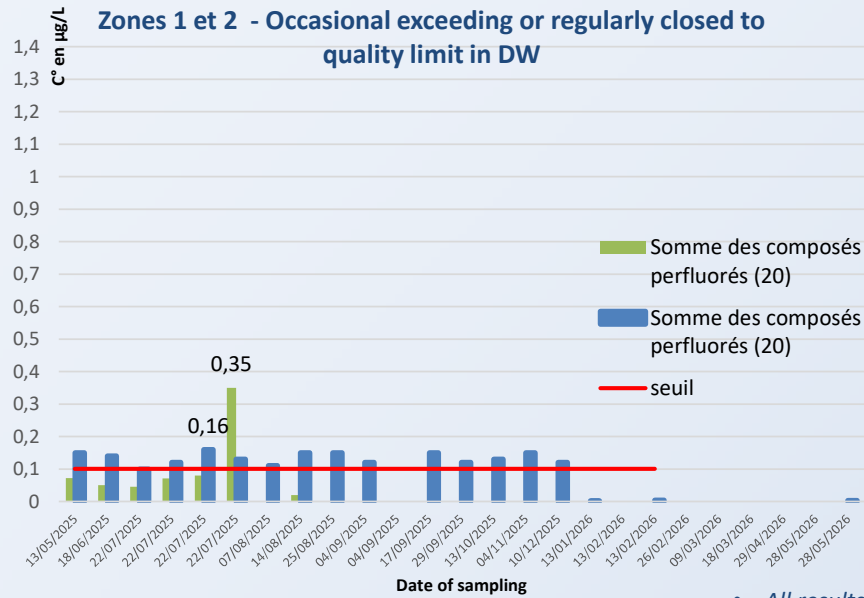
➤ Campaign and sampling plan :

3 zones around industrial water treatment stations

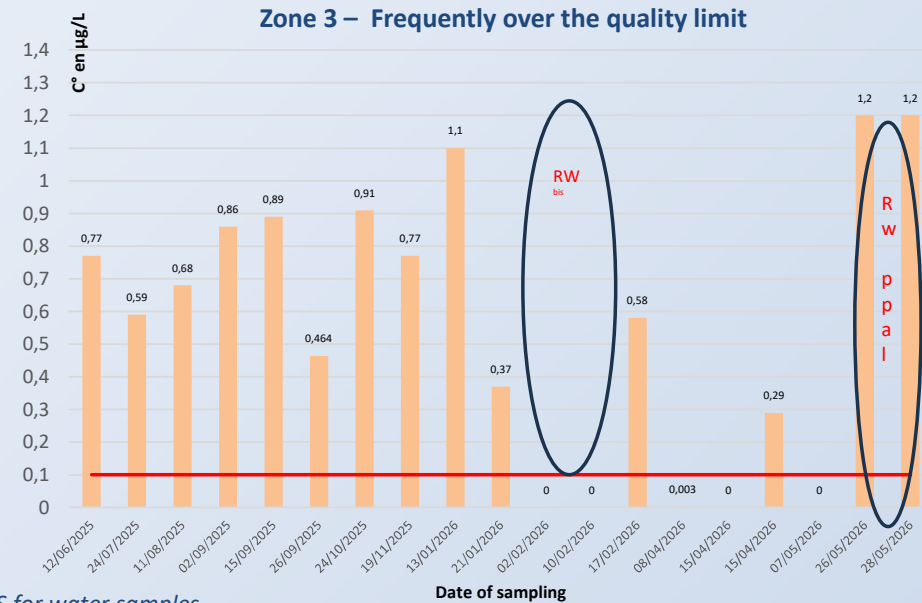
- ★ Raw and drinking waters
- ▲ Sludges and wastewater samples from textile
- Farmland soils (culture, pasture) and reference soils (garden, pasture)



02-2 Historical DW PFAS data



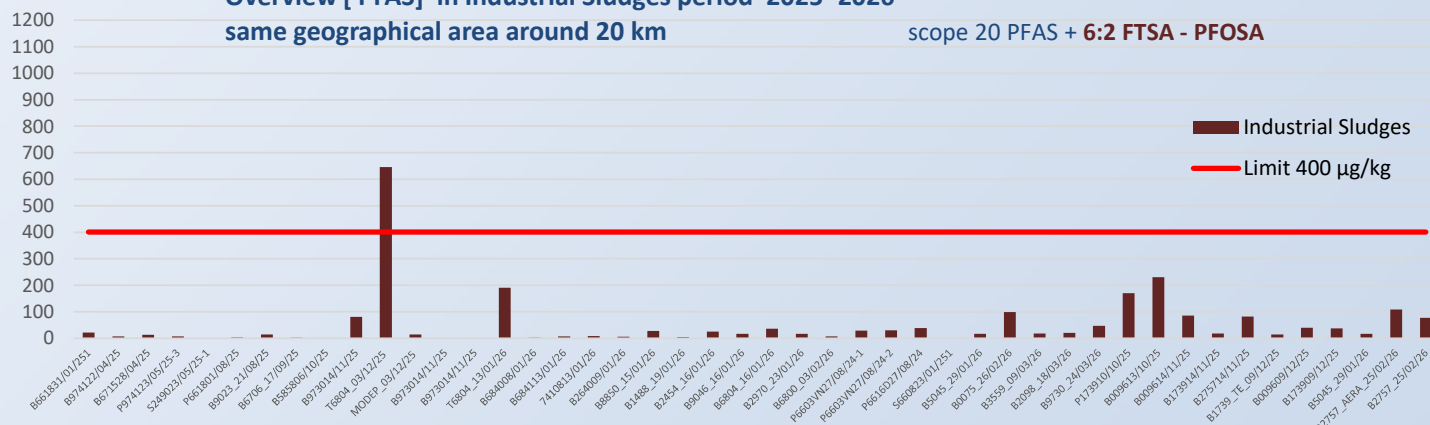
• All results from ARS for water samples



C° en µg/kg MS

Overview [PFAS] in Industrial Sludges period 2025–2026 same geographical area around 20 km

scope 20 PFAS + 6:2 FTSA - PFOSA



03 Analytical approach

❖ Target PFAS Analysis

Large broad scope of different PFAS families (>70 compounds), including:

long, short and ultra short PFAS chains

terminal, precursors and different functional groups are represented (acid, sulfonamide, alcohol, ester, ...)

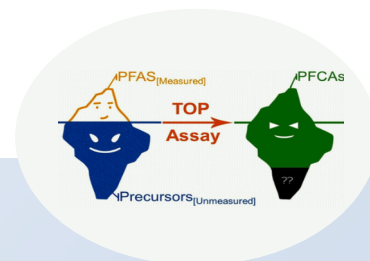


Standard methods applied for LCMSMS :

- EN 17892 water
- PR EN ISO 2565 soils-sludge
- Work in progress for TFA in water

❖ TOP* = Total Oxidizable Precursor

Conversion by oxidization of precursors PFAS (known and unknown) to commonly known and analyzed non degradable perfluoroalkyl acids (PFCA) also called terminal PFAS. Analyze of extracts with marker of oxidization completeness by LCMSMS



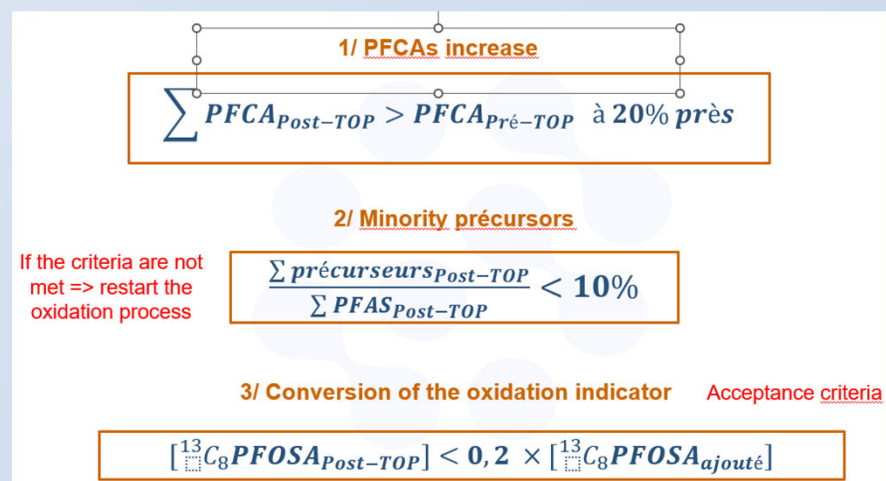
Method based on Houtz and Sedlak

(Environ. Sci. Technol. 46 (2012) 9342–9349)

Routine quality control and acceptance criteria following publication

X Dauchy Vol.:(0123456789) Analytical and Bioanalytical Chemistry

<https://doi.org/10.1007/s00216-025-05902-3>



Strengths & Limitations

➤ LCMSMS – targeted method

➤ TOP Assay + LCMSMS

LCMSMS – targeted method		TOP Assay + LCMSMS	
Advantages 😊	Limitations 😞	Advantages 😊	Limitations 😞
Standardized method	Methods in progress or not started / limited scope : TFA - FTOH	A better overall picture of [PFCAs]	Some PFAS do not oxidise
High sensitivity (low LOQs)		High sensitivity (low LOQs)	Oxidation may be incomplete if the matrix is complex
Quantification of the PFAS compounds	Availability of standards	Method suitable for routine use	No standardised method;
Selectivity			
Robust and routine method for labs	//	More realistic view of the environmental impact	Difficult interpretation / total PFAS – USC ?

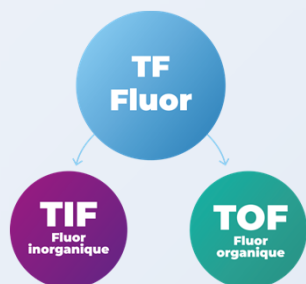
**Results of both methods used for
PHOENIXS study**

03 Analytical approach

Overview of the analytical methods

Provides a comprehensive overview of fluorinated pollution (pesticides – PFAS – and polymers fluorinated)

- ❖ **TOF – Total organic fluorine**
Indirect method => TF - TIF



CIC

- TF / EN 17813 - CIC
- TIF/ EN ISO 10304-1 - CI

Strengths & Limitations

Advantages 😊

Global fluorine measure close to the total PFAS

No interference issue

Non-targeted method, useful for pollution monitoring

Enable a fluorine mass balance of fluorine

Disadvantages 😞

all organic fluorine not just PFAS – overestimated [PFAS]

No identification of the compounds

Low selectivity

Complex results interpretation

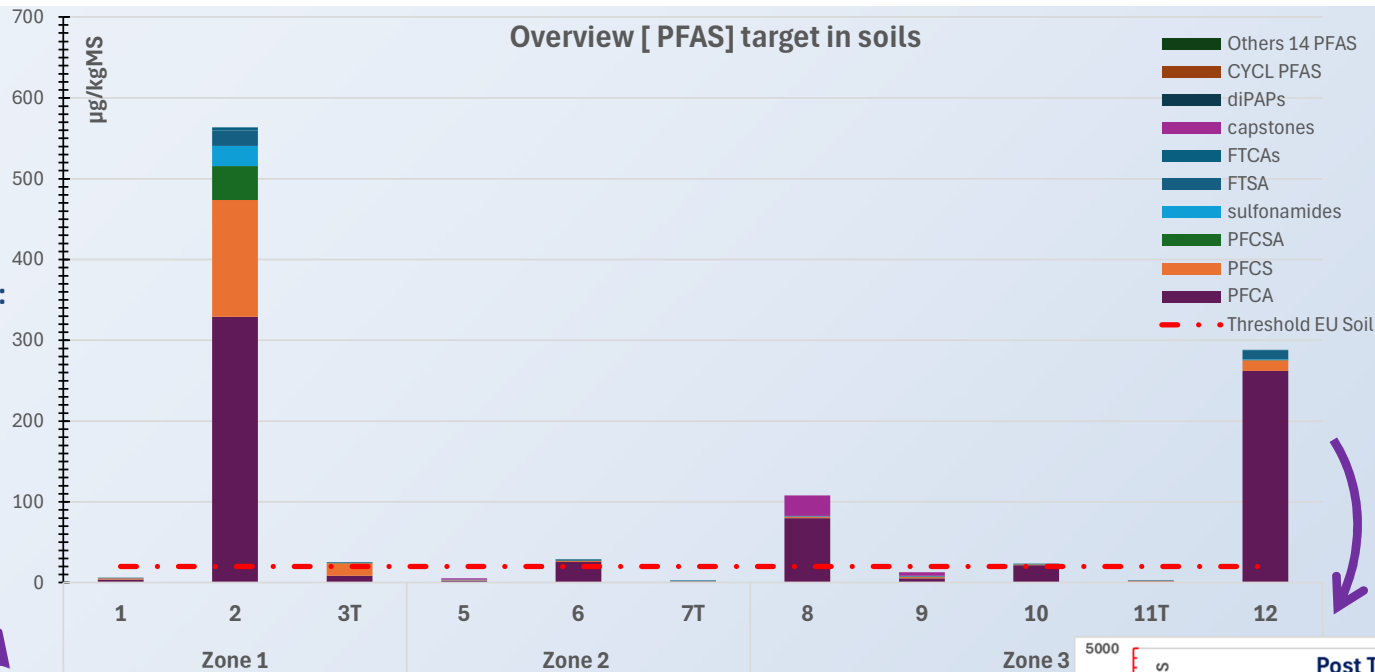
Results from this method are NOT used for PHOENIXS study



04-1 Results PFAS - Soils

⇒ Study reference soils are lower than the threshold*

⇒ Soils with sludge-spreading : mostly PFCAs but precursors quantified

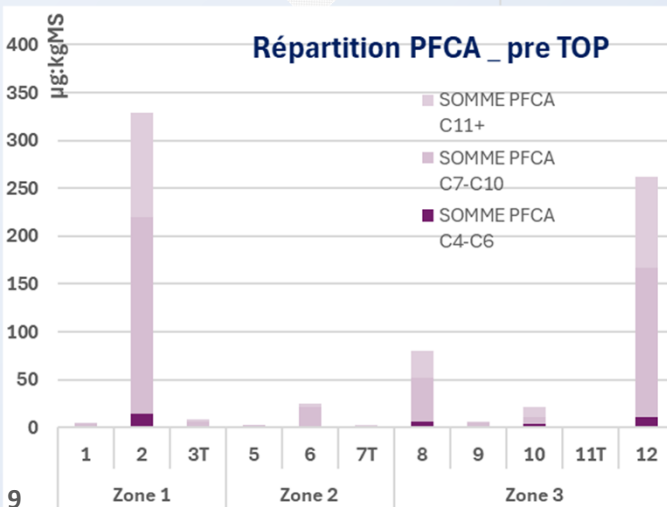


Threshold Natural Background established : 20 µg PFAS/kg for soil

* source J Sauvé PFAS profiles in biosolids, composts, and chemical fertilizers intended for agricultural land application in Quebec (Canada) - ScienceDirect



+TOP Assay



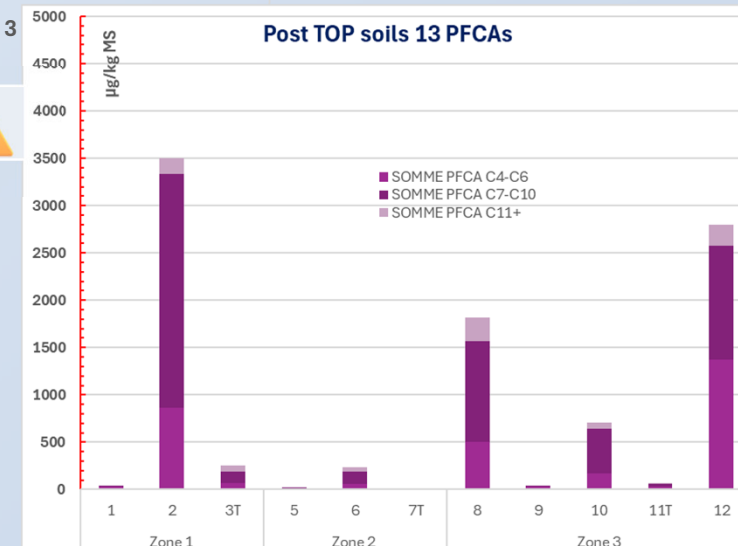
Hypothesis / analysis pre TOP

- precursors PFAS degraded in soil
- PFCA coming from historical sludge spreading

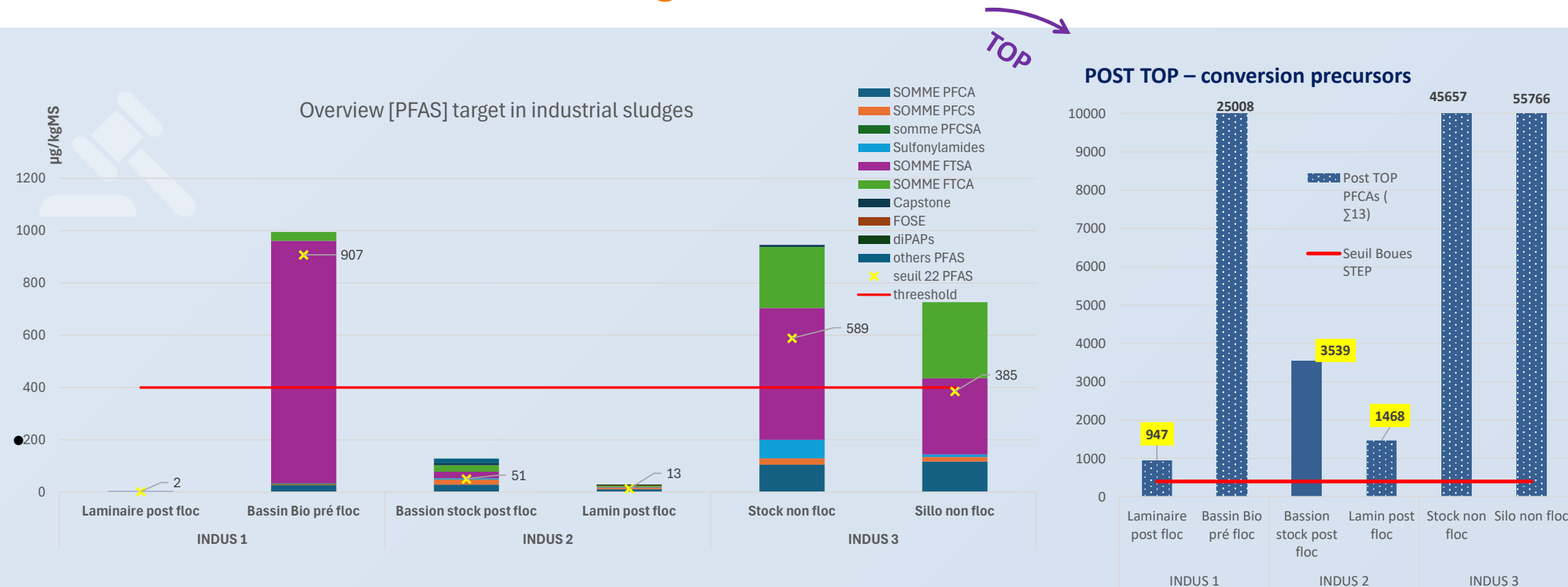
Hypothesis / analysis post TOP

- degradation are still happening
- unknown precursors present

Without TOP, pollution is underestimated



04-2 Results PFAS – Sludge



PFAS Target analysis 50% of sludge respect upcoming regulation :

- Precursors dominant concentration (FTSA / FTCA)
- Flocculation process might impact PFAS concentration

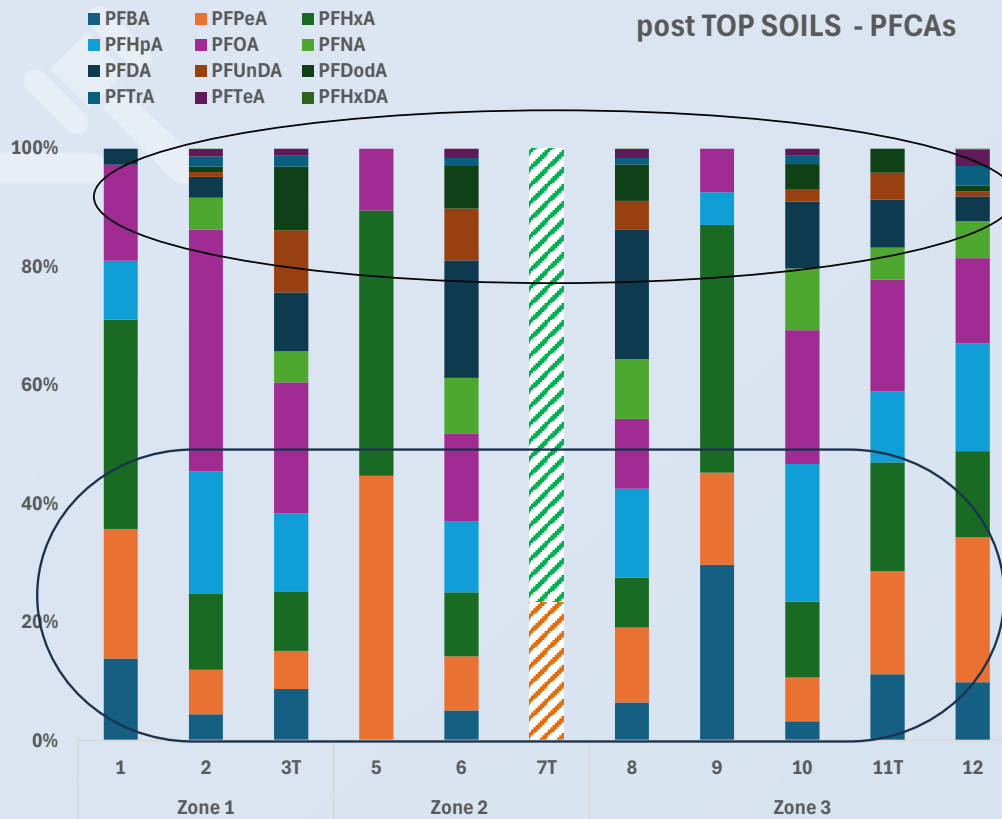
TOP assay reveals 100% of sludge is non compliant

➔ Unknown precursors are degraded in regulated PFCA target



04-3 PFAS profile

- Analysis of the relative composition (%) of each detected PFAS (>LOQ) based on the results from the post-TOP Assay.

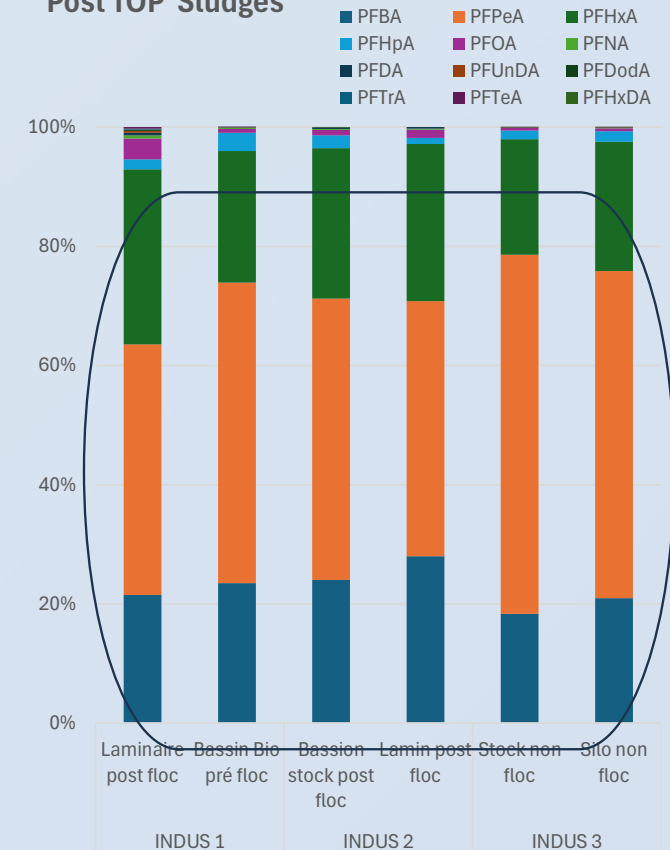


PFAS
history



Same PFAS
markers

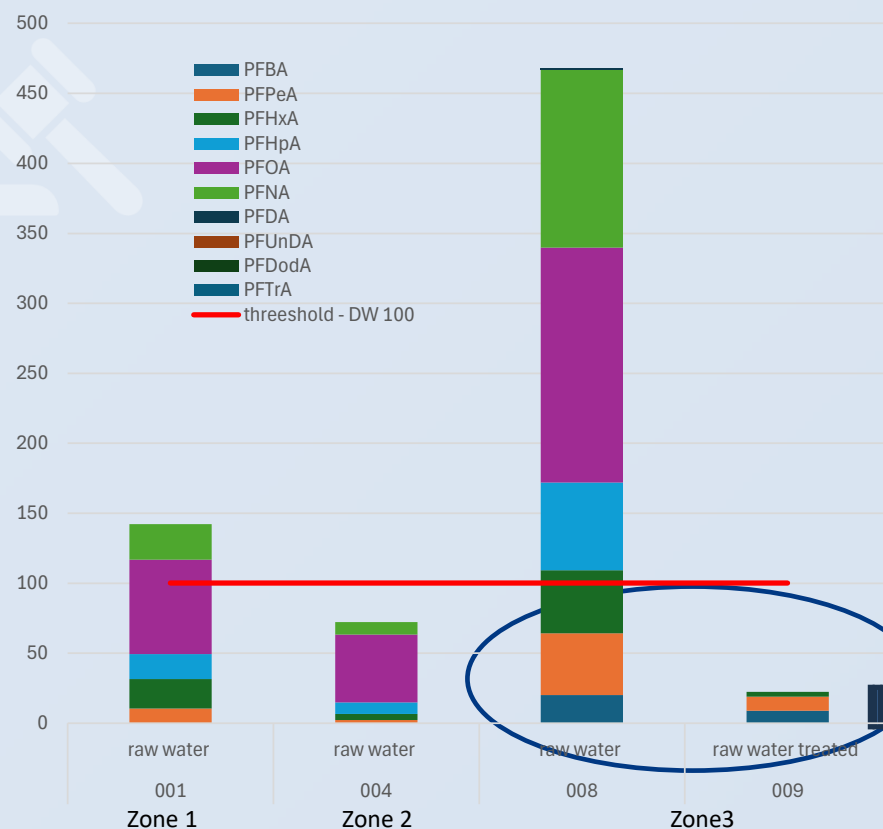
Post TOP Sludges



- Signature of current sludge profile found in the soil
- But other sources revealed => different origin spreading : papers-milk industry / old textile sludge process ?
- Need to investigate soils with sludge spreading to do PFAS risk assessment

04-4 PFAS profile in DW

TOP DW -



➤ New data from PHOENIXS study sampling for DW are consistent with monthly monitoring ARS values

➤ Efficiency of treatment to prevent high level pollution

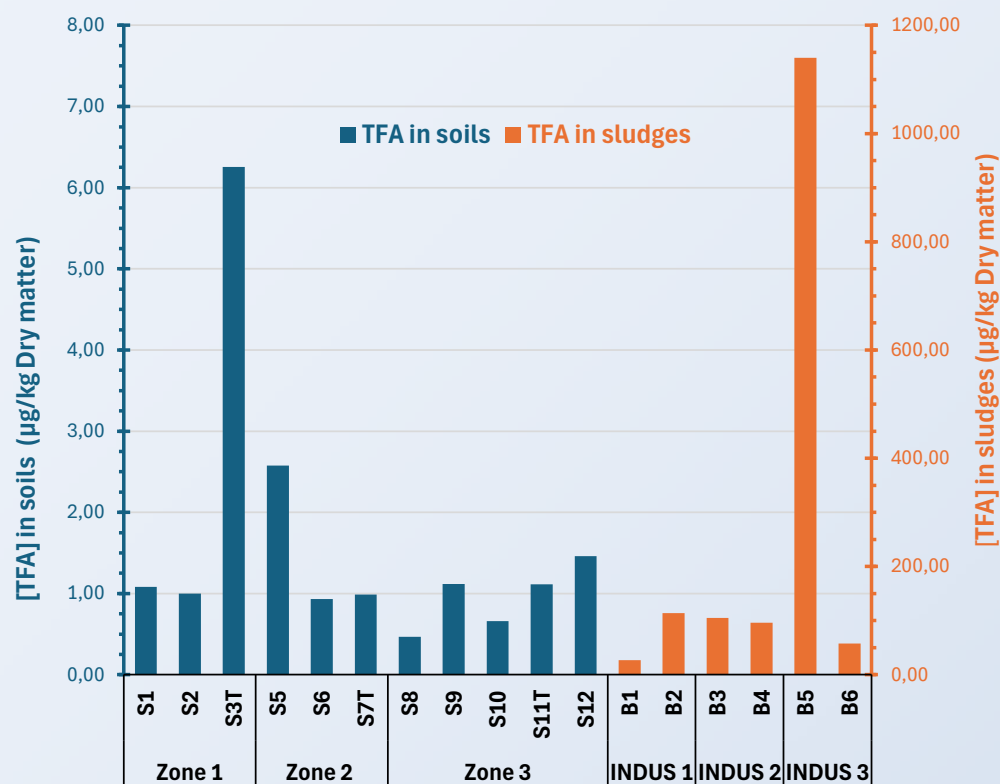
Raw Water treatment efficient for removal of PFAS including TFA in response of regulation (Activated Carbon filter)

- Repartition of PFAS in Raw Water shows **presence of short chain and PFCA mostly**, no measurable precursors or long chain present
- TOP ASSAY does not increase significantly the concentration of PFCA => **no unknown precursors present**

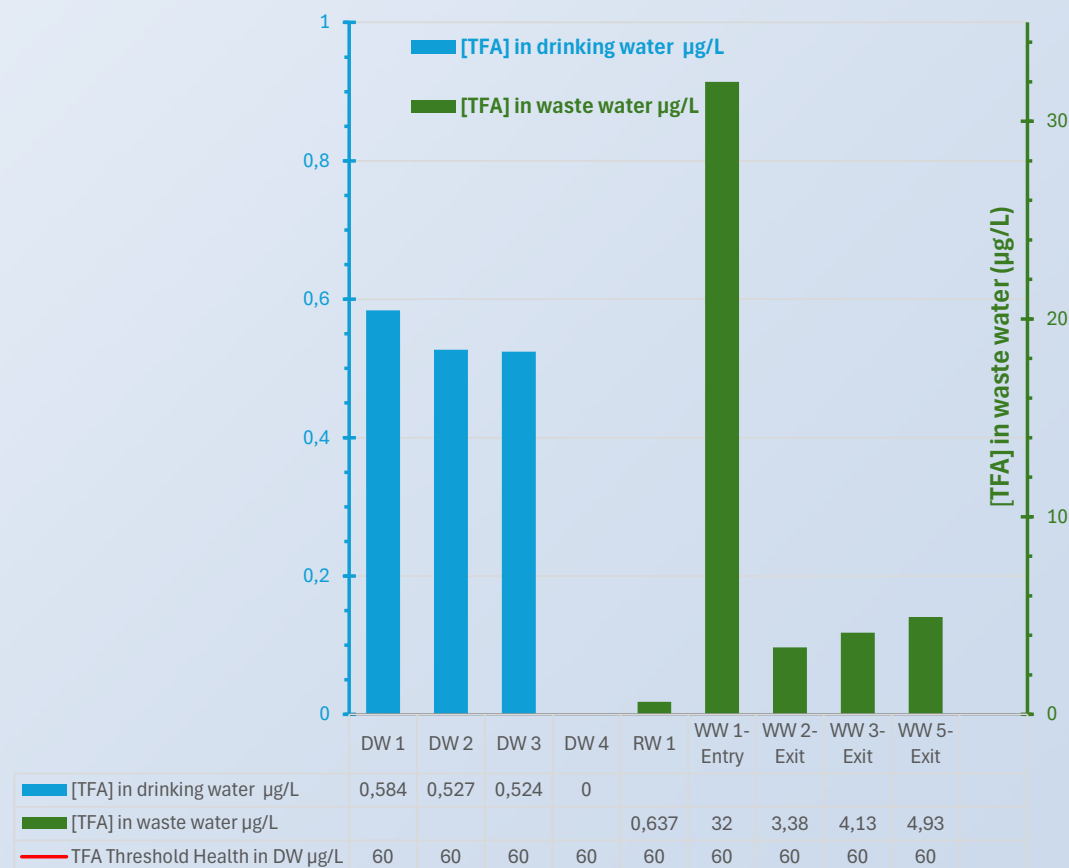


04-5 TFA RESULTS

[TFA] in soils and sludges



[TFA] in drinking water (DW) & waste water (WW)



TFA was detected in all the samples analyzed

=> the DW4 site demonstrates the effectiveness of treating raw water by filtration, even for TFA.



05 Conclusion

Summary of study results

Soil enriched with industrial sludges contaminated in PFAS

Sludge identified as a source of contamination with TOP Assay profile

Presence of precursors degradation in soils

Monitoring PFAS

need to investigate **soils with sludge spreading** current and historical
TOP assay analytical approach is important especially with old sludges spreading and to
show the level of PFAS pollution.

Mobility of PFAS

Hypothesis : degradation of precursors occurs in soil and migration
of PFCA with shorter chain towards raw water is detected.

⇒ **identifying the source of PFAS** pollution in drinking water

Conclusion from this study, the pollution is still ongoing



05 Conclusion and further approach

Feedback on current regulation :

Analytical scope of > 70 PFAS doesn't assess fully the risk from sludge spreading.

=> Only 50 % of sludges contamination detected
with current regulated list (Σ 22 PFAS)

TOP ASSAY is a relevant tool to evaluate pollution level
in soils and sludges. Without, PFAS pollution is underestimated.

=> 100 % sludges become NON compliant with **list Σ 22 PFAS**.

=> Highlighting the delayed dangers of PFAS in soil.

Emphasis the need to improve in PFAS monitoring

Regarding DW : Analytical approach and list of PFAS regulated are relevant

Establishment of regulation values will be key to assess widespread TFA contamination





Thanks for your attention

Any questions ?



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