

# SFSE



Société  
Francophone  
de Santé  
et Environnement

La rigueur scientifique au service des publics

## **The SFSE management guideline for PFAS : contamination sources, environmental behavior and risk assessment**

**Marie JAILLER – Secretary of the human health risk assessment methodology Working Group of SFSE**

**International Congress on PFAS - Management of environmental and health risks - 20 octobre 2022**

# The human health risk assessment methodology

## Working Group of SFSE



### Aims

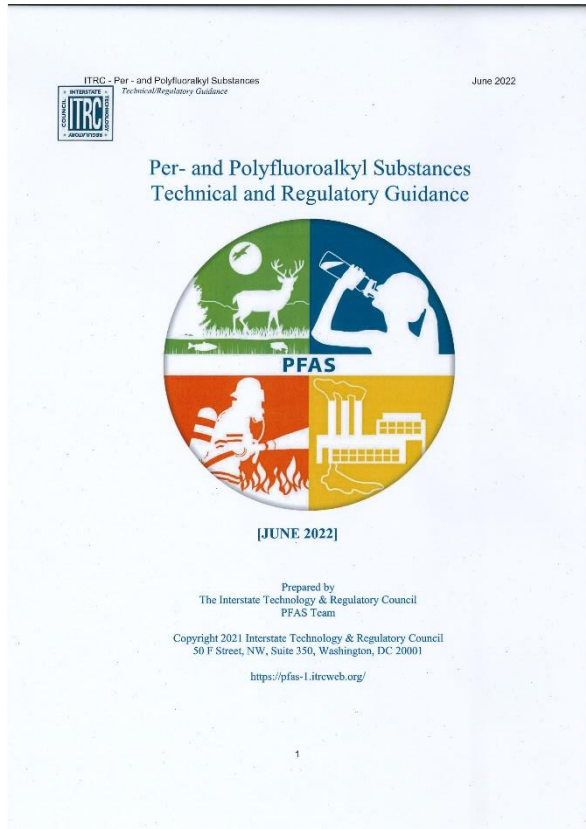
- To encourage exchanges between members, outside an institutional context
- To contribute to improving the usefulness and practice of health risk assessment
- To broaden the theme: from health risk assessment to health impact assessment

### Meetings and results : a pragmatic approach

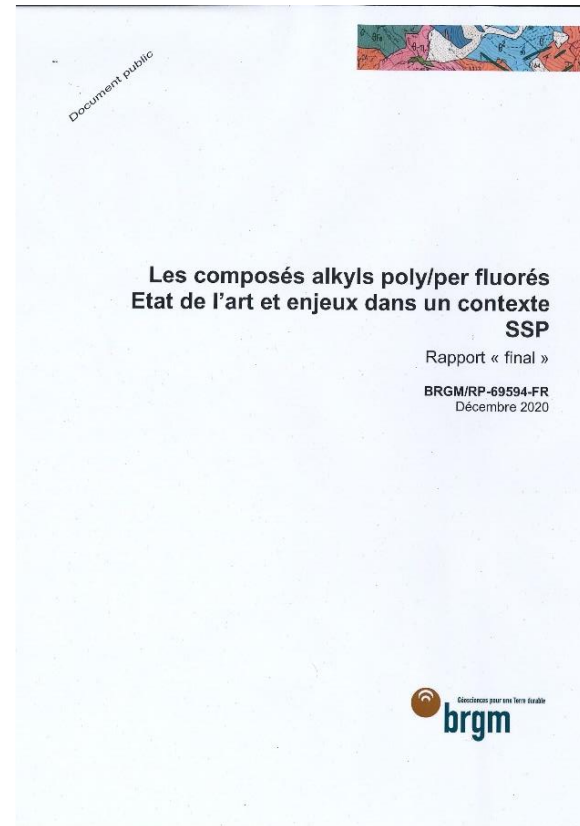
- President : Christophe ROUSSELLE and secretary : Marie JAILLER
- 3 - 4 meetings/year (in Paris or by Teams)
- Discussions about news in the risk assessment field, presentations
- Each year, volunteers work on a topic selected altogether
- Publication of the results in a scientific paper in « Environnement, Risques et Santé »
- Topic 2015 : the children specificities in the risk assessment, Topic 2016 : the dermal contact exposure, Topic 2017 : the co-exposures, Topic 2019-2020 : the different kinds of health risk/impact assessments

### → Topic 2022 : PFAS

# Lots of information and data...and evolving data



In English, 542 pages – New edition : June 2022



En français, 177 pages (2020)

How to get a good view about PFAS face to this flood of information?

# The human health risk assessment methodology : how to deal with PFAS?

## Step 1 : Data collection and Conceptual exposure model

Where sample is needed: in soil, sediment, groundwater, surface water, air ?  
Which PFAS to analyse in this large family (4700 compounds) ?

## Step 2 : Toxicity assessment

Which values for vapor pressure, solubility, Koc, Kow ?  
Which toxicity reference values ?

## Step 3 : Exposure assessment

What are the main exposure pathways?  
How to take into account the mixture?

## Step 4 : Risk characterization

Are results suitable with analytic limit of quantification ?  
Is a sustainable remediation possible ?

## Step 5 : Uncertainties

There are everywhere...



# The SFSE management guideline :

## Technical fact sheets

- To give pragmatic information and recommendations to authorities, service providers
- To prepare fact sheets, free available on the SFSE website (in French)

Fact sheet	Topic
1	General information, identity (names), chemical data
2	Regulatory data
3	Sources
4	Environmental behaviour and biotransformation
5	Sampling protocols
6	Analysis protocols
7	Determination of the background concentrations
8	Environmental behavior : Physical-chemical parameters
9	PFAS toxicity and Toxicity Reference Values
10	Mixture
11	Human biomonitoring data
12-13-14	Remediation technologies in soil, water and air

# First contamination in Europe and first public information



2004 : Norway, Sweden (using of PFAS-foam on airports and military sites)

2016 : Germany (Düsseldorf Airport using PFAS-containing firefighting foam)

2021 : Belgium (manufacturer of PFAS)

2022 : France (manufacturer of PFAS)

2022 : Italy (manufacturer of PFAS)

# Manufacturer of PFAS - Belgium



## **La Flandre secouée par un scandale environnemental qui nous concerne tous**



June 2021 : article in the national newspaper

Title : “Flanders shaken by an environmental scandal that affects us all”

- Kind of activity : manufacturer of PFAS
- Company : 3M
- Location : Zwijndrecht, near Antwerp (Belgium)
- Date of public information : June 2021

Source : rtbf.be

# Manufacturer of PFAS - Belgium

## Environmental sampling

Soil, groundwater, eggs, surface water (172 samples in streams, canals and rivers)

Results → contamination in soil, groundwater, surface water and eggs

High concentration of PFAS in eggs in a 15 km perimeter around the site

## Consequences

June 2021 : People living within a radius of 15km from Zwijndrecht being advised not to consume eggs laid in their own or anyone's else's gardens. Pregnant women and children also have to watch out for vegetables from one's own garden

November 2021 : the Flemish Environment Agency (VMM) is planning to conduct a large-scale study in groundwater to measure PFAS in 250 wells

March 2022 : 3M company was found responsible for the contamination

April 2022 : Authorities decide to organise a human biomonitoring on population in Zwijndrecht – (around 60,000 to 70,000 people) in January 2023 (blood samples) - 7.500 volunteers already registered

July 2022 : American company 3M has agreed to pay € 571 million including € 100 million in damages to the Flemish regional government as part of an agreement on the clean-up of contaminated soil in the area around the plant

September 2022 : Epidemiologic study shows no significant increase of cancers in the Zwijndrecht area



# Manufacturer of PFAS - France



ENVIRONNEMENT

Jeu 26 Mai 2022 à 06h08

## Pollution aux perfluorés près de Lyon : deux arrêtés préfectoraux pour renforcer la surveillance d'Arkema et Daikin



Source : Lyonmag.com

May 2022 : article in the local newspaper

Title : « PFAS pollution near Lyon : 2 regulations to improve the survey of ARKEMA and DAIKIN »

September 2022 : TV investigation report on national TV (France 2)

- Kind of activity : manufacturer of PFAS
- Companies : ARKEMA and DAIKIN
- Location : Pierre Bénite, near Lyon (France)
- Date of public information : May 2022 (newspaper)

# Manufacturer of PFAS - France

## Environmental sampling

Soils, outdoor air, at the water discharge pipe of the facility, at the tap water, in the surface water (le Rhône)

[PFAS in soils] > 6 x Dutch limit value (3 µg/kg)

[PFAS at the water discharge pipe] = 190 – 1500 x [PFAS upstream]

[PFAS in tap water] > 2 x the European limit value for sum of 20 PFAS (0,1 µg/L) but [4 PFAS \_ EFSA] < 0,1 µg/L

## Human biomonitoring

Breast milk samples on 13 volunteers initiated by the TV investigation

Results: [PFOA in breastmilk] = variable results but in the same order of magnitude than results of a French study (2011) [1]

## Consequences

Recommendations : Closure of the public area (stadium), no use restriction of drinking water

June 2022 : Authorities decide to start a large and intensive survey (every day) of PFAS emissions in water

September 2022 : A general study about PFAS at national level is initiated

[1] Antignac JP and al. Occurrence of perfluorinated alkylated substances in breast milk of French women and relation with socio-demographical and clinical parameters: results of the ELFE pilot study. Chemosphere. 2013 May;91(6):802-8. doi: 10.1016/j.chemosphere.2013.01.088. Epub 2013 Mar 7. PMID: 23473698.

# Manufacturer of PFAS - Italy

September 2022 : TV investigation report in Belgium (Solvay is a Belgian chemist)

Title : « Neighbours of a SOLVAY site are 5 times more exposed to PFAS, belgium scientific called the contamination of concern »



Source : rtbf.be

- Kind of activity : manufacturer of PFAS
- Companies : SOLVAY
- Location : Spinetta Marengo (near Gênes) - Italy
- Date of public information : September 2022 (TV Investigation)

# Manufacturer of PFAS - Italy

## **Human biomonitoring**

Blood samples on 31 volunteers in Spinetta and around and 21 volunteers in Alessandria at 5 km

Median [PFAS in blood in Spinetta] > 5 x [PFAS in blood in Alessandria] or [PFAS in blood in Walloon population in Belgium]

## **Epidemiologic study by ARPA (2019)**

Population survey from 2001 to 2017 (comparison Spinetta – Alessandria)

Increasing of risks for liver cancer (+30%), kidney cancer (+79%), poumon disease (eg BPCO) (+47%), neurological disease (+30%)

Significant data from a statistical point of view...but no proof of evidence for a causal relationship

## **Consequences**

Authorities decide to organise a human biomonitoring on the entire population of Spinetta in February 2023

# List of the PFAS sources

## N°1 : airports, military and industrial sites using firefighting foams



Source : [www.leparisien.fr](http://www.leparisien.fr)



Source : [www.golder.com](http://www.golder.com)



Source : [www.francebleu.fr](http://www.francebleu.fr)

*Special case:  
The offshore installations are  
the main source in Norway*

Source : Climate and pollution agency (2012).  
Inventory of PFOS and PFOS-related substances in  
fire-fighting foams in Norway

List of the PFAS sources  
N°2 : Industrial facilities that produce PFAS  
the most famous but not the only ones



Until 2000, 3M company was the principal worldwide manufacturer

In 2006, US-EPA initiated the « 2010/2015 PFOA Stewardship program »  
→ participation of these 8 companies to the phaseout of long-chain PFAS

Source logo : [www.3M.com](http://www.3M.com), [www.arkema.com](http://www.arkema.com), [www.asahi-yukisai.co.jp](http://www.asahi-yukisai.co.jp), [www.basf.com](http://www.basf.com), [www.clariant.com](http://www.clariant.com), [www.daikin.eu](http://www.daikin.eu),  
[www.dupont.com](http://www.dupont.com), [www.solvay.com](http://www.solvay.com)

Source : <https://pfas-1.itrcweb.org/>



# List of the PFAS sources

## N°3 : the industrial facilities using PFAS

Type of industry	Advantages of PFAS
Firefighting foam	Ability to create a thin film between the foam and burning liquid
Building and construction	Strength and durability in the wood-based materials Gloss and antistatic properties in paints and varnishes
Cable and wiring	Coating PTFE over wires
Metal finishing and plating	To limit the development of bubbles and the emission of Cr VI aerosols at workplace during electroplating
Industrial surfactants → cosmetics	Oil and water repellent, smoothing,
Paper products and packaging	Fat and water repellent (grease-proofing)
Photolithography/ semiconductor	Surface-active properties, antireflective coating
Textile and leather	Protective barrier : Water, fat and dirt repellents

# List of the PFAS sources at the end of the life cycle

The qualities of PFAS in the industry (persistence, no biodegradation) become the high disadvantages to make them disappear → few kinds of treatment of soil or water are efficient to wipe out PFAS

## Solid waste management facilities



<https://www.ledevoir.com/>

## Wastewater treatment facilities



<https://www.actu-environnement.com/>

## Sewage sludge application



<https://www.notre-planete.info/>



<https://swiver.io/>





# (Common) Environmental behavior what we know

For most of PFAS:

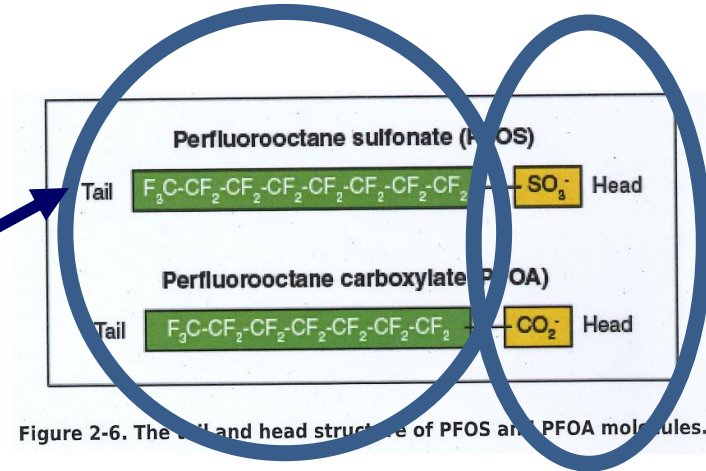
- In the environnement (where  $5 < \text{pH} < 9$ ) : anionic form
- Low sorption to soil and sediments (charge -)
- High solubility in water (charge +)
- Low volatility
- Long-distance dispersion in groundwater (like benzene or TCE)
- Biodegradation of precursors in acid form (more toxic, more persistent)

More present in  
surface  
water/groundwater  
than in  
soil/sediments



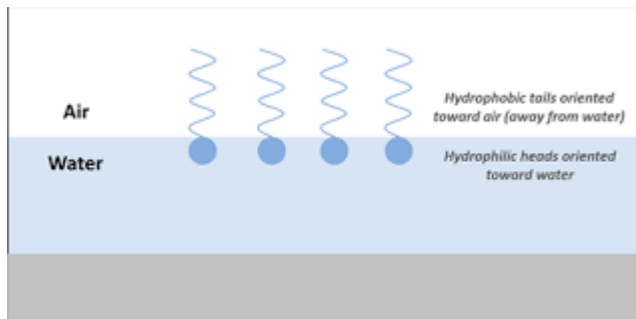
# (Common) Environmental behavior what we know and... to explore

Hydrophobic



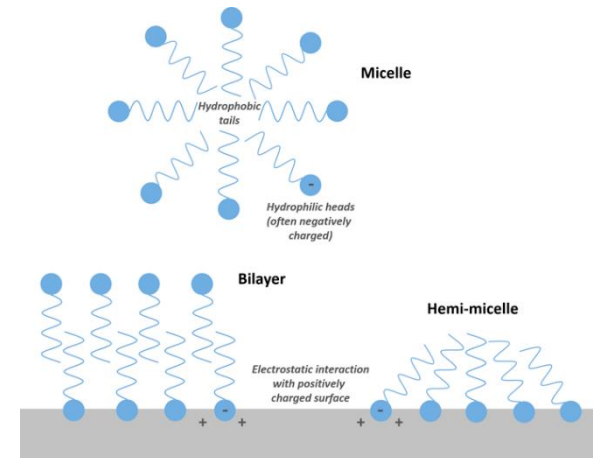
Hydrophilic

Figure 2-6. The tail and head structure of PFOS and PFOA molecules.



→ Accumulation at the air-water interface (capillary fringe)

But  
change in  
behavior  
(transport)



→ Aggregation into « micelles »  
at high concentrations

# (Common) Environmental behavior what we don't know yet



For most of PFAS:

- Complete data only for PFOS and PFOA
- Scattered values for key parameters like : vapour pressure, solubility, Henry's constant, Koc (soil adsorption), Kow (hydro-lipophilic/hydro-lipophobic)
- Difficulties to select the right (the less bad?) values due to available data for different forms of the compound (anionic/acid)
- In « micelle » form (colloidal) → lipophilic, different behavior

Recommendations:

- To measure the PFAS sorption on site (instead of using a Koc value per default)
- To take care about the form (anionic/acid) before selecting a value
- To select sampling points in groundwater or surface water far from the source
- To measure precursor substances

# (Common) Environmental behavior

## Sampling and analysing what we know

Recommendations during the sampling phase,  
to avoid « false-positive »:

- To use sampling material containing no « fluor »
- To add lots of replicates and blank samples



<https://www.calligee.eu/>

Recommendations during the analysing phase,  
to allow a comparison with limit values (limit of  
quantification > maximal tolerable dose) :

- to select a « good » laboratory → few laboratories have a real ability to reach so low limits of quantification

# Human Exposure to PFAS in food

## EFSA study (2020)

PFAS are transferred from soil to plants (++ for short chain)

The main exposure pathways :

- Ingestion of (contaminated) food
- Ingestion of (contaminated) tap water

### Methodology :

- 67 839 food samples analysed in 16 european countries (33 000 in fish)
- PFAS selected : PFOA, PFNA, PFHxS, PFOS (other : around the LOQ)
- Food consumption habits in 19 european countries

Calculation of intakes (concentration in the food x food consumption) → the main exposure to PFAS comes from :

- fish : carp, eel (anguille), roach (gardon), perch, sardine
- fruit and fruit products
- eggs and egg products

# CONCLUSION

Thank you for your attention

Hoping that you get a right « Take-home message »

To know more about PFAS toxicity, come back after the lunch break at 14:00

→ another presentation of the SFSE Working Group by  
Dr Sylvaine RONGA-PEZERET and Pascal DE GIUDICI

