HOLOWAVES

email : contact@holowaves.fr Destruction de PFAS

Defluorination of PFAS through an innovative cold plasma process

7th International PFAS Congress, June 16–19, 2026 • Pierre-Marie MONDIN – Christophe LOUVIGNE •

Intellectual Property Protection

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Intellectual property

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About Holowaves

A French greentech

Holowaves *by Holopharm* develops a physical water decontamination process, with no consumables, no chemicals, and no mechanical filtration.

Our technology targets PFAS, PFOS, and TFA by breaking the carbon–fluorine bond

4	2016	CIR
R&D engineers	PFAS research and development	Until 2030

Context and objectives

Context

- **2019 — Customer request.** Initial request from a customer following an issue identified with Triton X100.
- **Scientific study — University of Rouen.** Evaluation of destruction processes for short- and long-chain PFAS, with a focus on TFA.
- **Birth of Holowaves.** Spin-off from the Holopharm laboratory dedicated to the remediation of contaminated water.
- **Four partners involved.** Experimental trials aimed at degrading PFAS down to their mineralization into fluorides.
- **Broad concentration range.** From several ppb up to tens of g/L
- **Independent analyses.** Entrusted to a third-party laboratory to ensure objective results.

Objectives

- **Current energy target.** Below 100 Wh per 1 L at a concentration above 10 g/L of PFAS and/or TFA.
- **Aqueous matrices.** Adapt to all aqueous matrices
- **Consumer.** Provide a solution for consumers

Value chain

Our partners:

Excavation of contaminated soil or areas

Audit
Critical situation • Volume

Concentration
of pollutants in leachate
1 / 1000 m³
PFAS < 10 g/L

Fluoride valorization

Demand
Government –
Institutions
Businesses
Individuals

Holowaves project
Concentrate treatment
1 L/h • 100 W/h
20 L/h • 2000 W/h

Tests
Toxicological
OECD 249

Institutions

Business
Individual

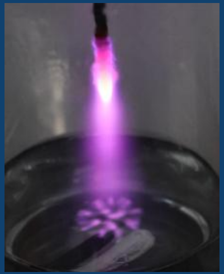
Return to nature

Independent analysis laboratories: Situation monitoring, duplicate testing. Every step is validated by an independent laboratory test and approval from the requester.

Process

Water contaminated

Reactor Holowaves



Water decontaminated

Concentrations

From a few ppb to several tens of g/L

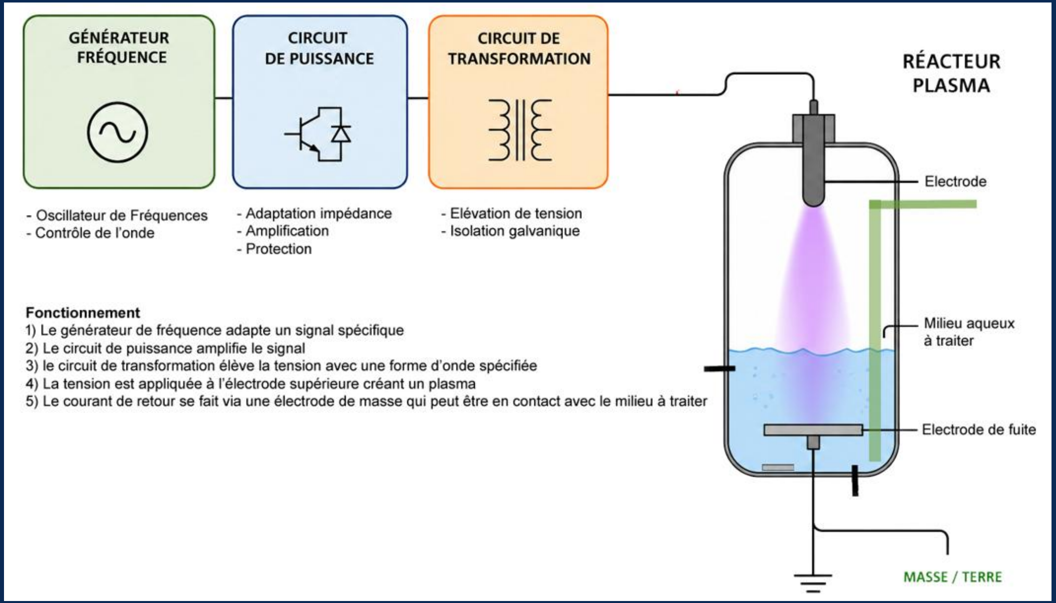
No consumables

No gas
No chemical additives
No activated carbon

Energy consumption

1 L/hour – 100 W/hour.
$1m^3$ /hour – 100 kW/h -> 1 / 1000
Operating cost of the full process: €16 / m^3
(EDF price €0.10 / kW)

Process



Flow

Can be set up in series or in parallel
From 200 mL to several liters

Maintenance

Low maintenance cost

Add-on

Can be integrated into an existing process
Complementary to another solution

Sample origin

Industrial effluents

99.0%

Chemical and pharmaceutical industry

Customer case — French pharmaceutical group.
Fluorinated active ingredient: Health Authority
Fluorinated effluents from the process of an anticancer drug:
~1 m^3/month,
>10 g/L.
Destruction **99%**.
Customer laboratory

Environmental water treatment

99.1%

Runoff, PFAS

Customer case — Complex leachates.

A company specialized in treating runoff water from underground waste.
Concentrate 1/1000
Holowaves process 18 L/h – 1800 W/h
Our process destroyed 99.1% of the **20 PFAS** targeted

Industrial treatment plant

94.3% / 66.5%

Customer case — Industrial water treatment at a plant

The customer provided two types of water-treatment plant samples for the 20 PFAS:

Sample 1: 94.3%
Sample 2: 66.5%

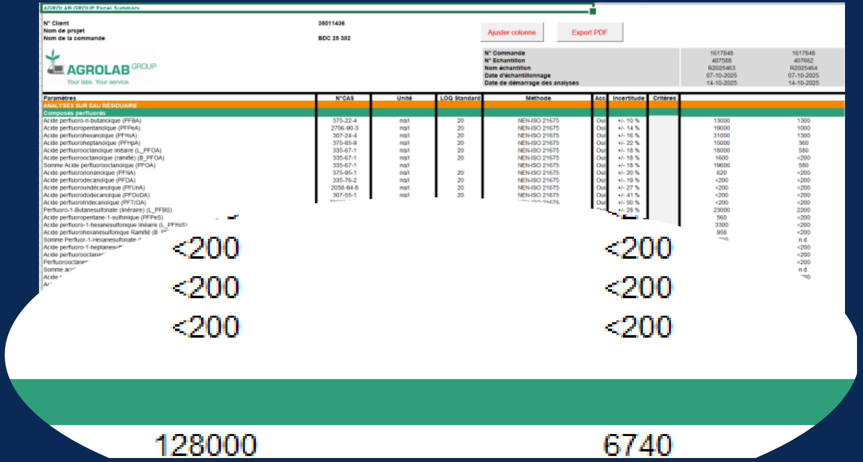
Spring water

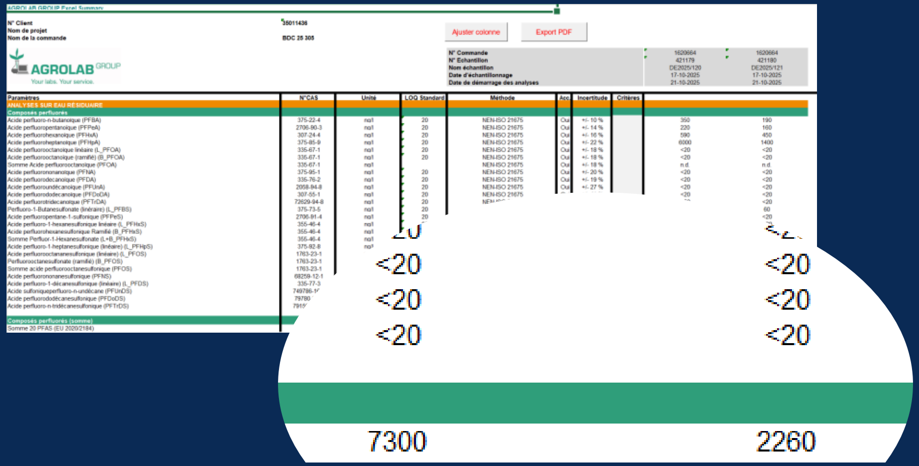
98.5%

Customer case – Spring water – request from the Eure prefecture

Screening of 100 PFAS
Concentration on the order of ppb
Our process destroyed 98.5% of the **100 PFAS** targeted

Before and after measurements – industrial treatment plant





94.3% and 66.5%

Measurements performed by AGROLAB laboratory

Before and after measurements Environmental water treatment

AGROLAB GROUP Excel Summary

N° Client	35011436
Nom de projet	
Nom de la commande	BDC 25 270

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N° Commande	1601451
N° Echantillon	321206
Nom échantillon	Holowaves 1
Date d'échantillonnage	02-09-2025
Date de démarrage des analyses	08-09-2025

Paramètres	N°CAS	Unité	LOQ Standard	Méthode	Acc.	Incertitude	Critères	
ANALYSES SUR EAU RÉSIDUAIRE								
Composés perfluorés								
Acide perfluoro-n-butanoïque (PFBA)	375-22-4	ng/l	20	NEN-ISO 21675	Oui	+/- 10 %		3800
Acide perfluoropentanoïque (PFPeA)	2706-90-3	ng/l	20	NEN-ISO 21675	Oui	+/- 14 %		8300
Acide perfluorohexanoïque (PFHxA)	307-24-4	ng/l	20	NEN-ISO 21675	Oui	+/- 16 %		13000
Acide perfluoroheptanoïque (PFHpA)	375-85-9	ng/l	20	NEN-ISO 21675	Oui	+/- 22 %		4600
Acide perfluorooctanoïque linéaire (L_PFOA)	335-67-1	ng/l	20	NEN-ISO 21675	Oui	+/- 18 %		7400
Acide perfluorooctanoïque (ramifié) (B_PFOA)	335-67-1	ng/l	20	NEN-ISO 21675	Oui	+/- 18 %		1500
Somme Acide perfluorooctanoïque (PFOA)	335-67-1	ng/l		NEN-ISO 21675	Oui	+/- 18 %		8900
Acide perfluorononanoïque (PFNA)	375-95-1	ng/l	20	NEN-ISO 21675	Oui	+/- 20 %		140
Acide perfluorodecanoïque (PFDA)	335-76-2	ng/l	20	NEN-ISO 21675	Oui	+/- 19 %		<100
Acide perfluoroundécanoïque (PFUnA)	2058-94-8	ng/l	20	NEN-ISO 21675	Oui	+/- 27 %		<100
Acide perfluorododecanoïque (PFDoDA)	307-55-1	ng/l	20	NEN-ISO 21675	Oui	+/- 41 %		<100
Acide perfluorotridecanoïque (PFTrDA)	72629-94-8	ng/l	20	NEN-ISO 21675				<100
Perfluoro-1-Butanesulfonate (linéaire) (L_PFBS)	375-73-5	ng/l	20					500000
Acide perfluoropentane-1-sulfonique (PFPeS)	2706-91-4	ng/l	20					480
Acide perfluoro-1-hexanesulfonique linéaire (L_PFHxS)	355-46-4	ng/l	20					710
Acide perfluorohexanesulfonique Ramifié (B_PFHxS)	355-46-4	ng/l	20					
Somme Perfluor-1-Hexanesulfonate (L+B_PFHxS)	355-46-4	ng/l						
Acide perfluoro-1-heptanesulfonique (linéaire) (L_PFHpS)	375-92-8	ng/l						
Acide perfluorooctananesulfonique (linéaire) (L_PFOS)	1763-23-1	ng/l						
Perfluorooctanesulfonate (ramifié) (B_PFOS)	1763-23-1	ng/l						
Somme acide perfluorooctanesulfonique (PFOS)	1763-23-1	ng/l						
Acide perfluorononanesulfonique (PFNS)	68259-12-1	ng/l						
Acide perfluoro-1-décanesulfonique (linéaire) (L_PFDS)	335-77-3	ng/l						
Acide sulfoniqueperfluoro-n-undécane (PFUnDS)	749786-16-1							
Acide perfluorododécanesulfonique (PFDoDS)	79780-39-5							
Acide perfluoro-n-tridécanesulfonique (PFTrDS)	791563-89-8							
Composés perfluorés (somme)								
Somme 20 PFAS (EU 2020/2184)								

<100
<100
<100
<100
<100

540000

AGROLAB GROUP Excel Summary

N° Client	35011436
Nom de projet	
Nom de la commande	BDC 25 276

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N° Commande	1604612
N° Echantillon	337480
Nom échantillon	Holowaves 2
Date d'échantillonnage	11-09-2025
Date de démarrage des analyses	12-09-2025

Paramètres	N°CAS	Unité	LOQ Standard	Méthode	Acc.	Incertitude	Critères	
ANALYSES SUR EAU RÉSIDUAIRE								
Composés perfluorés								
Acide perfluoro-n-butanoïque (PFBA)	375-22-4	ng/l	20	NEN-ISO 21675	Oui	+/- 10 %		<200
Acide perfluoropentanoïque (PFPeA)	2706-90-3	ng/l	20	NEN-ISO 21675	Oui	+/- 14 %		<200
Acide perfluorohexanoïque (PFHxA)	307-24-4	ng/l	20	NEN-ISO 21675	Oui	+/- 16 %		360
Acide perfluoroheptanoïque (PFHpA)	375-85-9	ng/l	20	NEN-ISO 21675	Oui	+/- 22 %		290
Acide perfluorooctanoïque linéaire (L_PFOA)	335-67-1	ng/l	20	NEN-ISO 21675	Oui	+/- 18 %		<200
Acide perfluorooctanoïque (ramifié) (B_PFOA)	335-67-1	ng/l	20	NEN-ISO 21675	Oui	+/- 18 %		<200
Somme Acide perfluorooctanoïque (PFOA)	335-67-1	ng/l		NEN-ISO 21675	Oui	+/- 18 %		n.d.
Acide perfluorononanoïque (PFNA)	375-95-1	ng/l	20	NEN-ISO 21675	Oui	+/- 20 %		<200
Acide perfluorodecanoïque (PFDA)	335-76-2	ng/l	20	NEN-ISO 21675	Oui	+/- 19 %		<200
Acide perfluoroundécanoïque (PFUnA)	2058-94-8	ng/l	20	NEN-ISO 21675	Oui	+/- 27 %		<200
Acide perfluorododecanoïque (PFDoDA)	307-55-1	ng/l	20	NEN-ISO 21675	Oui	+/- 41 %		<200
Acide perfluorotridecanoïque (PFTrDA)	72629-94-8	ng/l	20	NEN-ISO 21675	Oui	+/- 50 %		<200
Perfluoro-1-Butanesulfonate (linéaire) (L_PFBS)	375-73-5	ng/l	20	NEN-ISO 21675	Oui	+/- 28 %		4100
Acide perfluoropentane-1-sulfonique (PFPeS)	2706-91-4	ng/l	20	NEN-ISO 21675	Oui	+/- 39 %		<200
Acide perfluoro-1-hexanesulfonique linéaire (L_PFHxS)	355-46-4	ng/l	20	NEN-ISO 21675	Oui	+/- 29 %		<200
Acide perfluorohexanesulfonique Ramifié (B_PFHxS)	355-46-4	ng/l	20	NEN-ISO 21675	Oui	+/- 29 %		<200
Somme Perfluor-1-Hexanesulfonate (L+B_PFHxS)	355-46-4	ng/l		NEN-ISO 21675	Oui			n.d
Acide perfluoro-1-heptanesulfonique (linéaire) (L_PFHpS)	375-92-8	ng/l	20	NEN-ISO 21675	Oui	+/- 26 %		
Acide perfluorooctananesulfonique (linéaire) (L_PFOS)	1763-23-1	ng/l	20	NEN-ISO 21675	Oui	+/- 35 %		
Perfluorooctanesulfonate (ramifié) (B_PFOS)	1763-23-1	ng/l	20	NEN-ISO 21675	Oui	+/- 35 %		
Somme acide perfluorooctanesulfonique (PFOS)	1763-23-1	ng/l		NEN-ISO 21675	Oui	+/- 35 %		
Acide perfluorononanesulfonique (PFNS)	68259-12-1	ng/l	20	NEN-ISO 21675	Oui	+/- 29 %		
Acide perfluoro-1-décanesulfonique (linéaire) (L_PFDS)	335-77-3	ng/l	20	NEN-ISO 21675	Oui	+/- 47 %		
Acide sulfoniqueperfluoro-n-undécane (PFUnDS)	749786-16-1	ng/l	20	NEN-ISO 21675	Oui	+/- 37 %		
Acide perfluorododécanesulfonique (PFDoDS)	79780-39-5	ng/l	20	NEN-ISO 21675	Oui	+/- 41 %		
Acide perfluoro-n-tridécanesulfonique (PFTrDS)	791563-89-8	ng/l	20	NEN-ISO 21675	Oui	+/- 40 %		
Composés perfluorés (somme)								
Somme 20 PFAS (EU 2020/2184)		ng/L		Méthode interne	Oui			

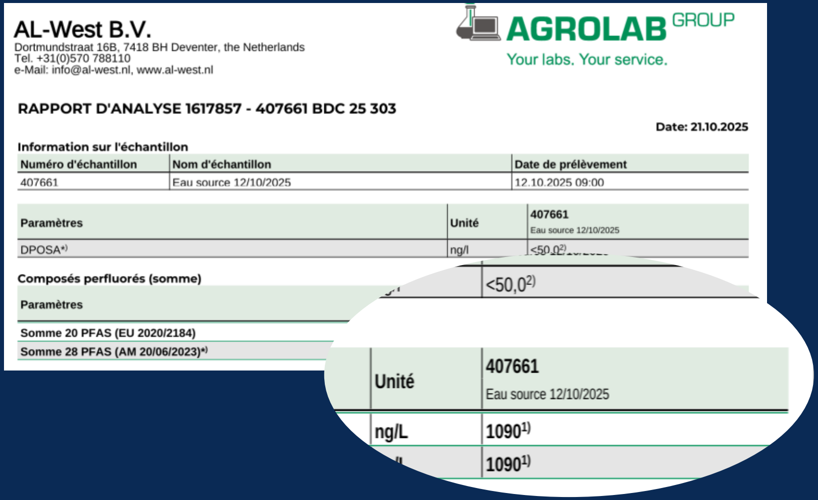
<200
<200
<200
<200
<200

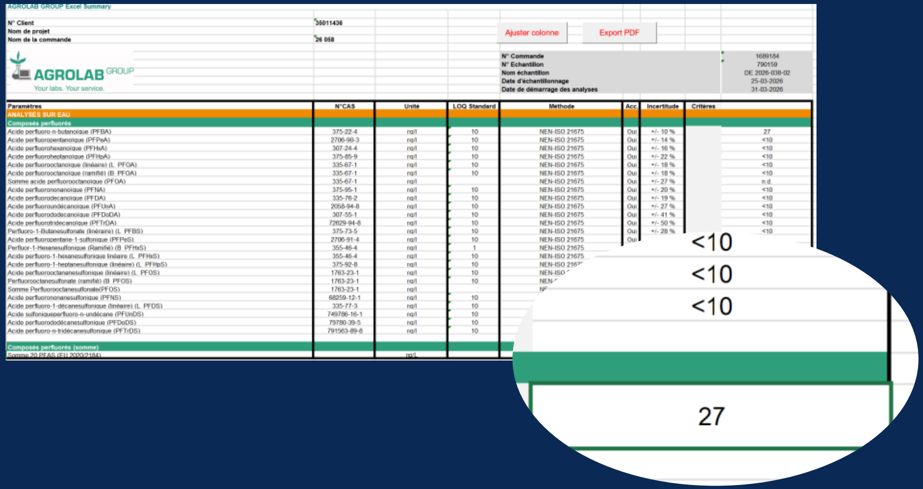
4750

Measurements performed by AGROLAB laboratory

99.1%

Before and after measurements Spring water

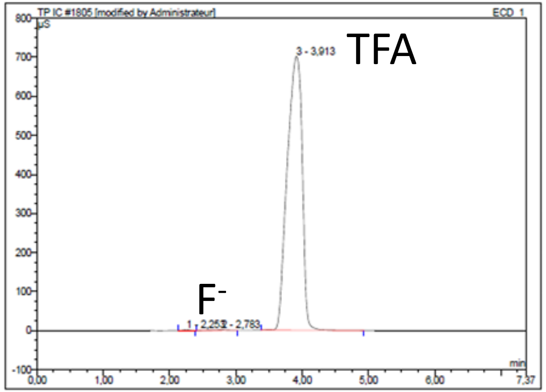




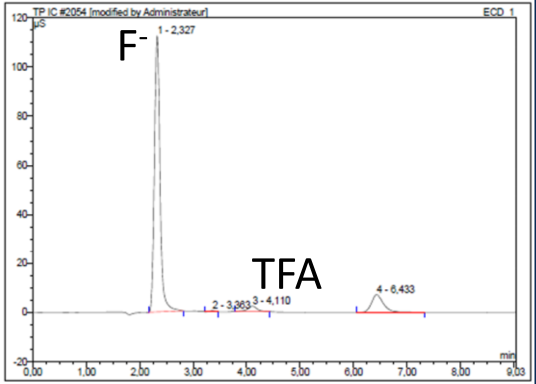
98.5%

Measurements performed by AGROLAB laboratory

TFA before and after measurements



No.	Ret.Time min	Area µS*min	Rel.Area %	Height µS	Resolution (EP)	Asymmetry (EP)	Plates (EP)
1	2,25	0,190	0,10	1,841	1,70	1,09	2919
2	2,78	0,371	0,20	1,339	2,51	0,78	591
3	3,91	183,182	99,69	701,203	n.a.	0,82	1230
Total:			100,000	704,383	4,21	2,688	



No.	Ret.Time min	Area µS*min	Rel.Area %	Height µS	Resolution (EP)	Asymmetry (EP)	Plates (EP)
1	2,33	13,733	85,64	112,537	5,73	1,17	2548
2	3,36	0,044	0,28	0,412	3,16	0,97	5684
3	4,11	0,453	2,82	2,191	6,85	0,93	3091
4	6,43	1,806	11,26	7,124	n.a.	1,27	4469
Total:			100,000	122,263	15,73	4,339	

- Ion chromatography – conductometry
- Analyses of fluoride ions and trifluoroacetates
- Reconstituted matrix at 220 ppm in water

PLANÈTE • PFAS

PFAS : l'Agence européenne des produits chimiques entérine la dangerosité du TFA, polluant éternel omniprésent dans l'eau et la chaîne alimentaire

L'acide trifluoroacétique est désormais officiellement considéré comme « toxique pour la reproduction suspecté ». Une décision qui pourrait avoir des effets en cascade tant cette molécule, la plus petite de la famille des PFAS, est présente dans l'eau potable et les aliments.

Par Stéphane Foucart et Stéphane Mandard

June 10, 2026

99.8%

Measurements performed by SMS laboratory Mont-Saint-Aignan

Conclusion

A solution ready to scale up to industrial use.

- Innovative process for decontaminating PFAS and TFA.
- Standard 220 V power supply, easing on-site integration.
- Low energy consumption.
- No consumables.
- The technology is particularly well suited for treating concentrated solutions of several tens of g/L
- Destruction rates of up to 100% depending on the treatment conditions.
- Easily adaptable to an existing process.
- It can also be used to complement another purification technology, as part of an overall treatment approach.
- Lastly, the solution offers a competitive investment cost for both industry and individuals.

Questions
& answers

Thank you for your attention

contact@holowaves.fr