



The LIFE SOuRCE project (LIFE20 ENV/ES/000880) has received funding from the LIFE Programme of the European Union



# Treatment of PFAS contaminated waters using SAFF – Surface Active Foam Fractionation

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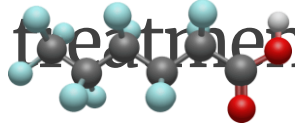
Chief Commercial Officer PFAS Europe

Envytech Solutions AB



# SAFF Surface Active Foam Fractionation

- A concentration  
treatment



Perflourinated substances has  
Hydrophilic head → Head loves water  
Hydrophobic tail → Tail hates water

The bubble becomes the perfect environment C6 PFAS  
and above – tail sticks in the bubble, easy to remove.

More scientific wording: Langmuir constant  
>1x 10<sup>-6</sup> can be caught

Some C6 and shorter chains (< 1 x 10<sup>-6</sup>) do get caught

**Primary step: 10 x conc increase**  
**Secondary Step: 1500 x conc increase**  
**Tertiary Step: 500-200 x conc increase**



# Concentration

## SAFF – Surface Active Foam Fractionation – Lets check it out

Primary Fractionation of raw leachate



Primary Fractionation of raw groundwater



10 x initial concentrations



# Concentration

## SAFF – Surface Active Foam Fractionation – Lets check it out

Secondary Fractionation

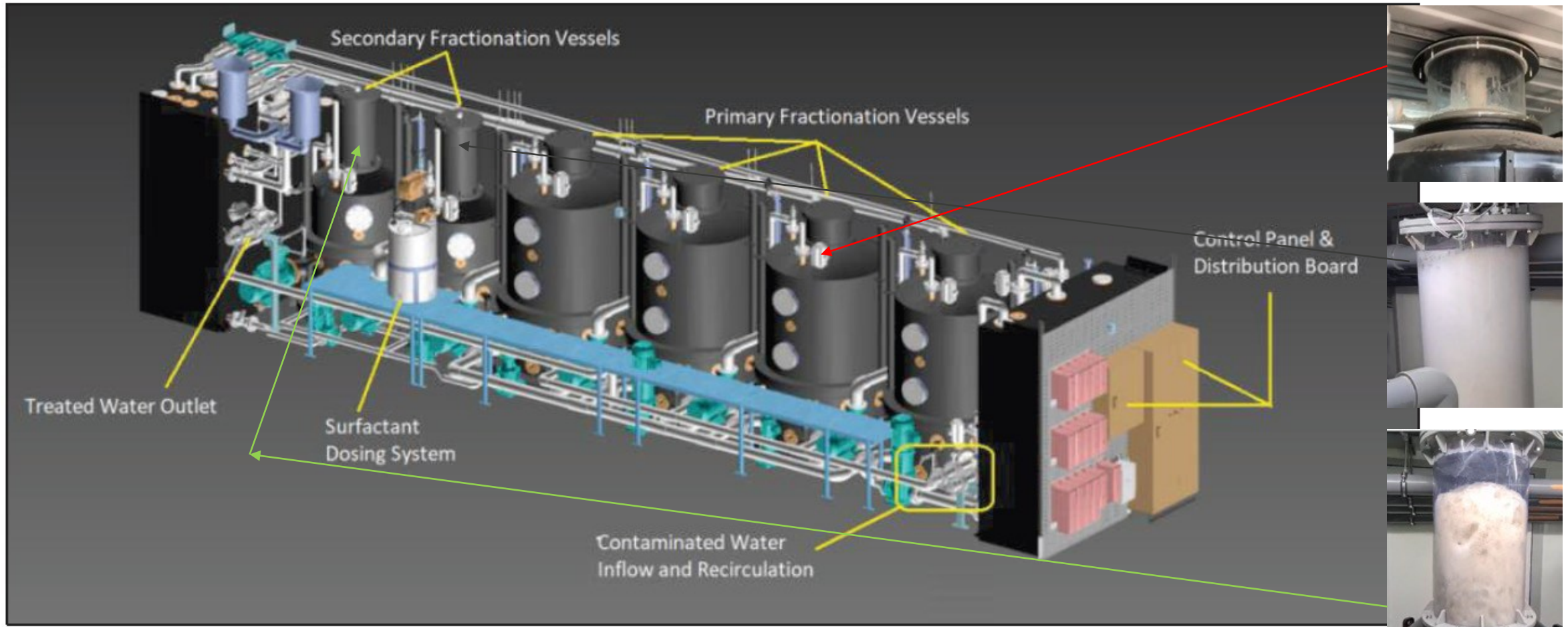


Tertiary Fractionation



And this is where the patent of this technology is situated, in large.  
Treatment in series to minimize waste, and the use of vacuum

# EPOC Envytech 20' containerised SAFF System





# Mobile treatment, winter isotated

“Plug and play” installation procedure

Tuning after start up – needed because all waters are different, approx. 2 days

Remote surveillance, fine tuning, 24h / 7 day controlled

You can follow flow, status, electricity used, total volume and more via the app!

Every pump, valve and sensor, reports data continuously. We can see exactly when, what and where a problem has occurred and can usually fix it remotely straight away



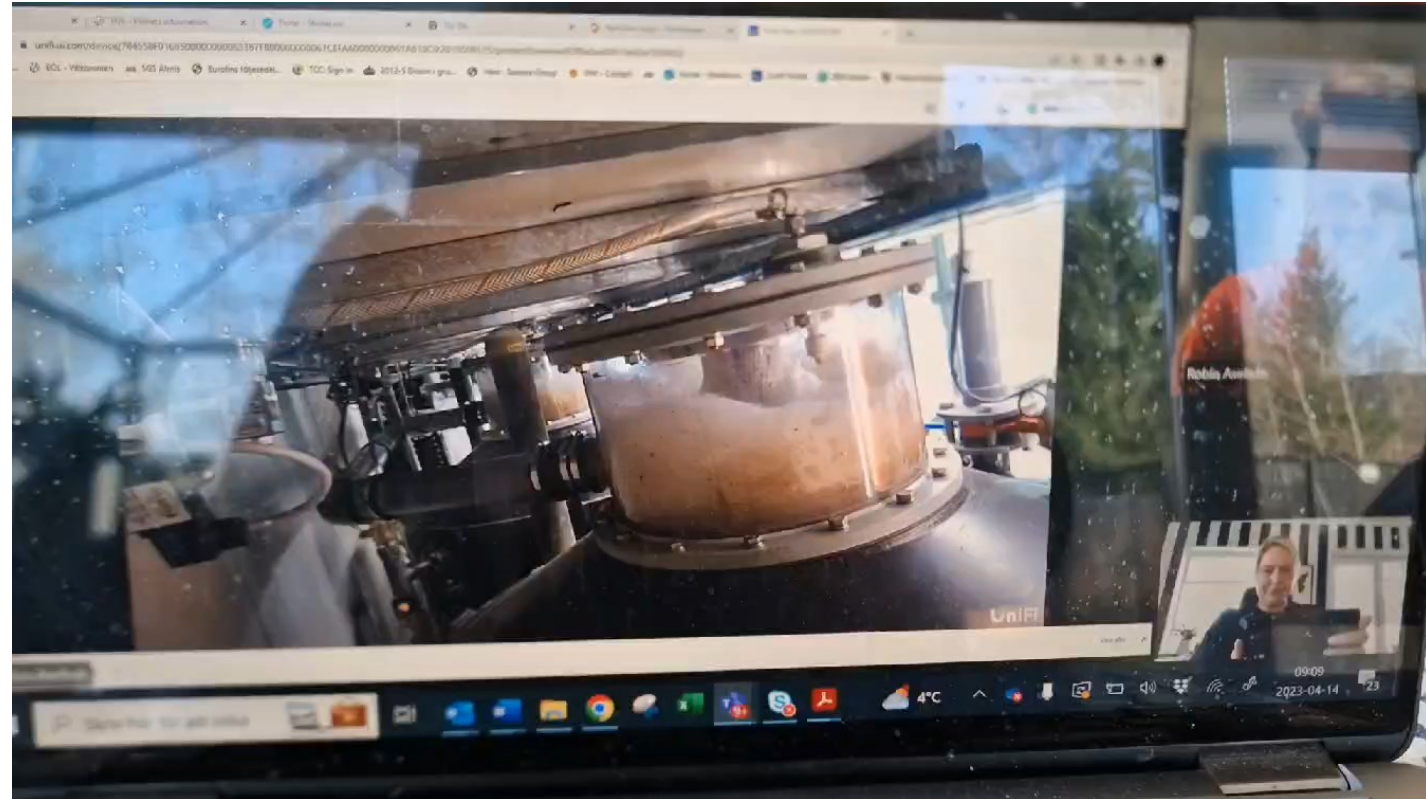
# Treatment control

SAFF is remotely surveilled by producers EPOC Enviro 24/7

Envytech staff can watch process, change settings for fine tuning of foam contro. Remotely

We train local staff at comissioning, so minimum cost will be spent on external service crew

Can "live" guide local staff for service, sampling or questions on the performance or all else.



The system is completely automatic and have work health and safety measures for minimizing possible contact with PFAS aerosols





# When and Why SAFF

SAFF is a very robust treatment option. PFAS removal efficiency is:

- ✓ NOT sensitive to PFAS levels (High/Low)
- ✓ NOT sensitive to pH
- ✓ NOT sensitive to Suspended particles  
DOM, DOC, Salinity
- ✓ Not sensitive to cross contaminants,  
(organics, metals, salts)

Further more

SAFF needs no pre treatment steps  
(bagfilter 200 um)

Capable of removing PFAS4 and PFAS6 up to 99,9%  
using no consumables or additives

Produces minimal waste amounts

Uses only electricity, 0,7 kwh/m3 treated

Proven technology with over 500 000 m3 treated





# Case Study

## EU LIFE

### Source

<b>Client:</b>	EU LIFE SouRCe
<b>Location:</b>	Spain
<b>Type of water:</b>	Groundwater at fire fighting test ground
<b>Pre-treatment:</b>	None
<b>Treatment:</b>	SAFF20
<b>Average flow:</b>	7-12 m <sup>3</sup> /h
<b>Waste:</b>	no measurable volume produced to date
<b>OPEX:</b>	0,7 kWh/m <sup>3</sup> treated 8h service/month



# Mini SAFF

Bench scale testing unit

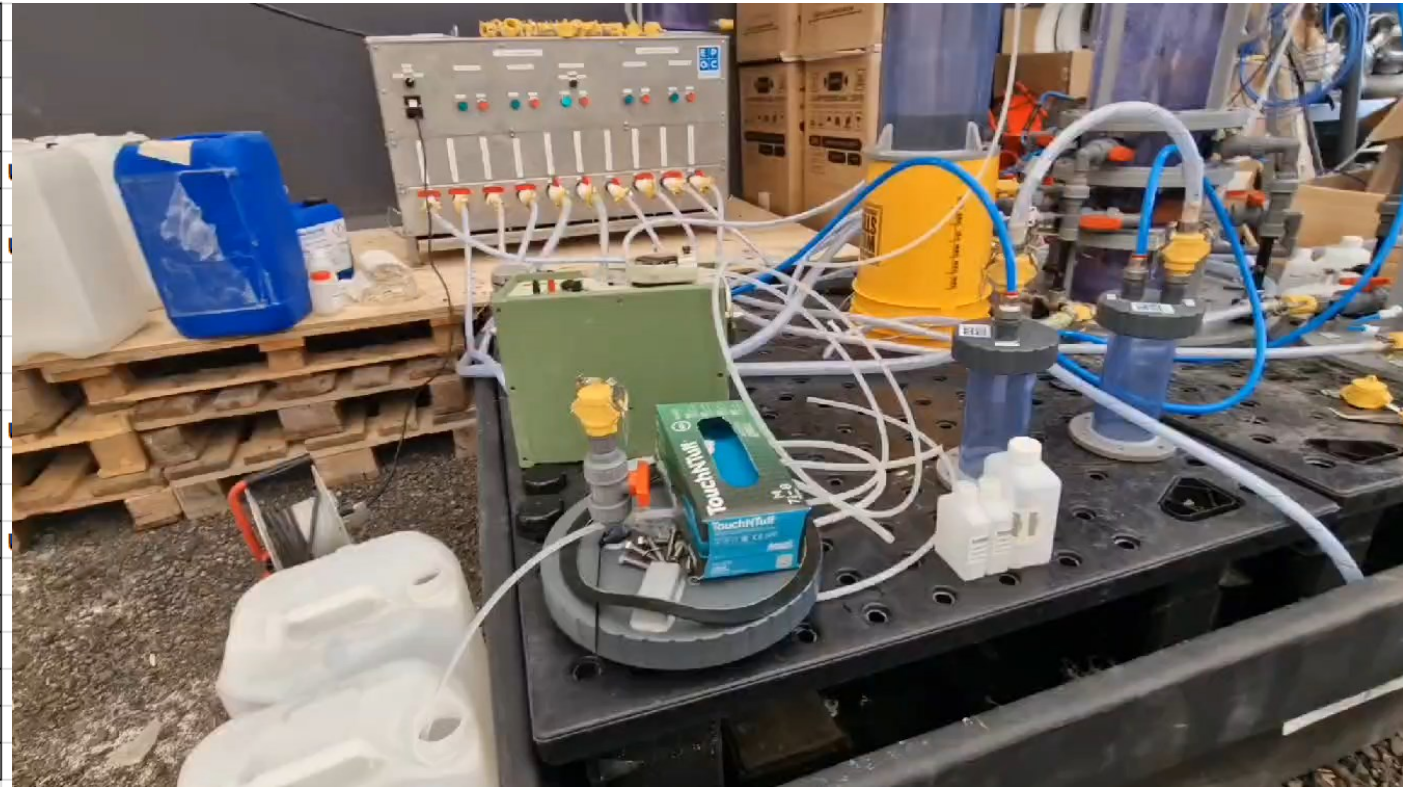




# Mini SAFF

Bench scale testing Spanish site  
No particles, no DOC, medium levels of PFAS

Provets märkning		Inlet	Treated water	Removal efficiency
PFOA, grenad	ng/l	8,6	<0,3	up to 99,9%
PFOA, linjär	ng/l	82	0,92	99%
PFOA, total	ng/l	91	0,92	99%
PFOSA	ng/l	0,3	<0,3	up to 99,9%
PFOS, grenad	ng/l	96	1,9	98%
PFOS, linjär	ng/l	230	5,7	98%
PFOS, total	ng/l	330	7,6	98%
PFNA	ng/l	15	<0,3	up to 99,9%
6:2 FTS	ng/l	990	13	99%
PFHpA	ng/l	280	43	85%
PFPeS	ng/l	34	12	65%
PFHpS	ng/l	6,6	<0,3	up to 99,9%
PFHxS	ng/l	210	4,8	98%
PFBA	ng/l	200	160	20%
PFPeA	ng/l	1300	1131	13%
PFHxA	ng/l	870	623	28%
PFBS	ng/l	35	28	20%
Summa 4 PFAS	ng/l	650	13	98%
Summa 11 PFAS	ng/l	4300	2000	53%
Summa 22 PFAS	ng/l	4300	2000	53%



# Full scale SAFF20 treatment results





# Case Study

## EU LIFE Source

### Groundwater

Full scale treatment at Spanish site. PFAS concentrations had changed compared to bench scale tests...

Provets märkning		Inlet	Treated water	Removal efficiency
PFOA, grenad	ng/l	8,6	<0,3	up to 99,9%
PFOA, linjär	ng/l	82	0,92	99%
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Summa 4 PFAS	ng/l	650	13	98%
Summa 11 PFAS	ng/l	4300	2000	53%
Summa 22 PFAS	ng/l	4300	2000	53%

Provets märkning		Inlet	Treated water	Removal efficiency
		2023-02-02	2023-02-02	2023-02-02
PFDA	ng/l	14	<10	Up to 99,9%
PFNA	ng/l	68	<10	Up to 99,9%
PFOS, total	ng/l	1 710 000	15	Up to 99,9%
PFOSA	ng/l	240	<10	Up to 99,9%
PFHxS	ng/l	130 000	65	Up to 99,9%
PFHxA	ng/l	10 000	110	99%
PFHpA	ng/l	23 000	520	98%
PFBA	ng/l	19 000	190	99%
PFBS	ng/l	13 000	65	99%
Sum 22 PFAS	ng/l	1 905 240	965	Up to 99,9%

Provets märkning		Inlet	Treated water	Removal efficiency
		2023-03-03	2023-03-03	2023-03-03
PFDA	ng/l	<10	<10	Up to 99,9%
PFNA	ng/l	<10	<10	Up to 99,9%
PFOS, total	ng/l	91 000	183	Up to 99,9%
PFOSA	ng/l	46	<10	Up to 99,9%
PFHxS	ng/l	5 700	390	93%
PFHxA	ng/l	470	230	51%
PFHpA	ng/l	860	830	4%
PFBA	ng/l	730	420	42%
PFBS	ng/l	1 200	290	76%
Sum 22 PFAS	ng/l	100 006	2 343	97%



# Case Study EU LIFE Source Groundwater

A great challenge has been the low flows and the very, changing incoming concentrations.

Flowrate 5 m<sup>3</sup> every 14th day

Concentrations 1000 ng/l- 2 000 000 ng/l

Challenge in knowing what water we sample.

**BUT**

<b>Total PFAS inkommande</b>	2 194 934
<b>Total PFAS utgående</b>	71 970
<b>Removal</b>	97%

No other treatment method could have handled this water with this removal efficiency without a lot of service works, and cost per m<sup>3</sup>, should the flows have been more constant.

	Inlet	Treated water	Removal efficiency
	2023-06-29	2023-06-29	2023-06-29
PFDA	<10	<1	Up to 99,9%
PFNA	<10	1,70	Up to 99,9%
PFOS, total	3 130	550	82%
PFOSA	18	4,1	77%
PFHxS	340	290	15%
PFHpA	170	190	-12%
PFHxA	470	480	-2%
PFBA	160	190	-19%
PFBS	61	67	-10%
6.2 FTS	950	620	35%
PFOA	84	60	29%
<b>Sum 22 PFAS</b>	<b>5 383</b>	<b>2 451</b>	<b>54%</b>

	Inlet	Treated water	Removal efficiency
	2023-10-09	2023-10-09	2023-10-09
PFDA	19,00	<1	Up to 99,9%
PFNA	11,00	<1	Up to 99,9%
PFOS, total	10 700	65	99%
PFOSA	37	<1	Up to 99,9%
PFHxS	1 700	970	43%
PFHpA	510	430	16%
PFHxA	1 800	1 700	6%
PFBA	730	760	-4%
PFBS	360	450	-25%
6.2 FTS	3 000	510	83%
PFOA	327	74	77%
<b>Sum 22 PFAS</b>	<b>19 164</b>	<b>4 959</b>	<b>74%</b>





# Next Step: Hovgården treatment site



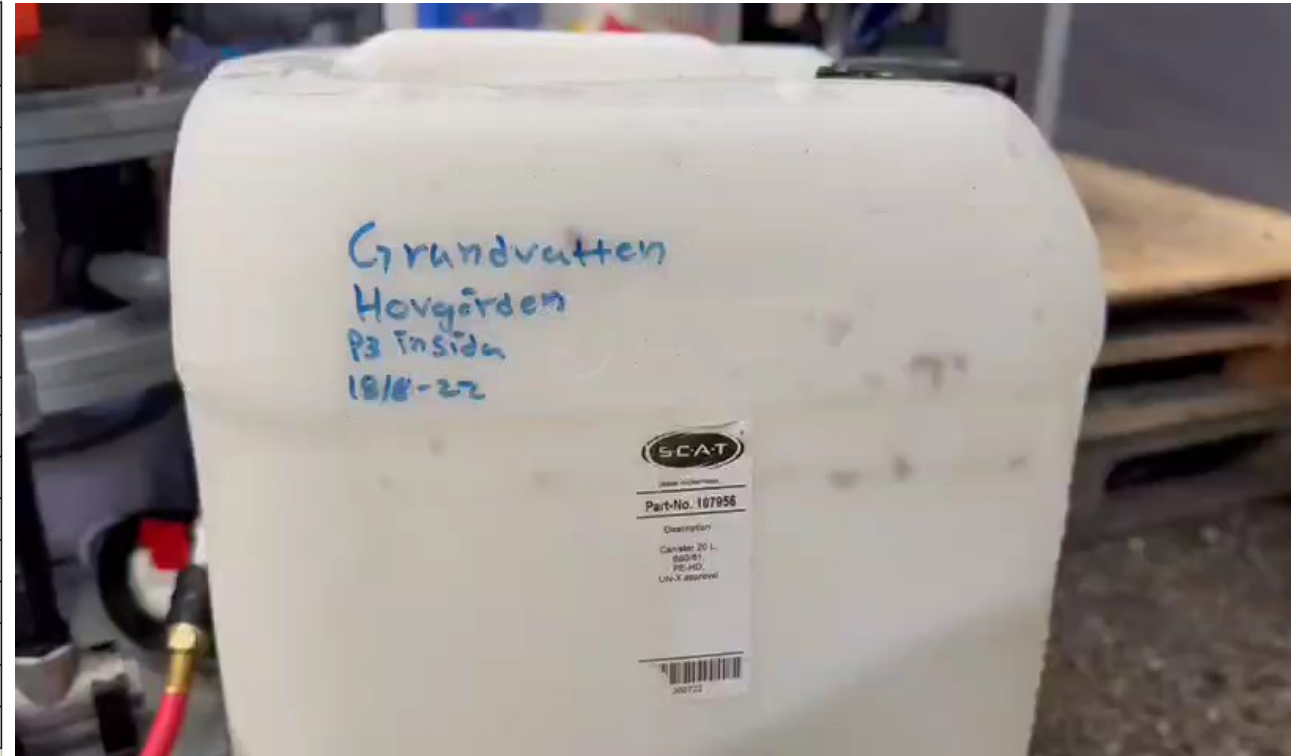
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# Mini SAFF

Bench scale testing Swedish site  
No particles, high DOC, high salts, possible co-contaminants, medium levels of PFAS

Ämne	unit	Hovgården Untreated	Hovgården treated	Removal Efficiency
6:2 FTS (Fluortelomer sulfonat)	ng/l	600	33	6%
8:2 FTS (Fluortelomer sulfonat)	ng/l	48	9	19%
PFNA (Perfluornonansyra)	ng/l	2,3	<1,0	up to 99,9%
PFDA (Perfluordekansyra)	ng/l	<1,0	<1,0	ND
PFBA (Perfluorbutansyra)	ng/l	290	220	76%
PFBS (Perfluorbutansulfonsyra)	ng/l	160	230	144%
PFHpA (Perfluorheptansyra)	ng/l	210	52	25%
PFHpS (Perfluorheptansulfonsyra)	ng/l	4,1	<1,0	up to 99,9%
PFHxA (Perfluorhexansyra)	ng/l	700	500	71%
PFHxS (Perfluorhexansulfonsyra)	ng/l	150	17	11%
PFOA (Perfluoroktansyra)	ng/l	320	8,7	3%
PFOS (Perfluoroktansulfonsyra)	ng/l	55	3,9	7%
PFPeA (Perfluorpentansyra)	ng/l	450	390	87%
PFPeS (Perfluorpentansulfonat)	ng/l	89	64	72%
Summa PFAS	ng/l	3100	1500	48%
Summa PFAS SLV 11	ng/l	2900	1500	52%





The race to find additives for short chain removal  
is on!

# SAFF

## Surface Active Foam Fractionation

- Ready for the future

All Full scale SAFF units are equipped with a  
Chemical dosing tank and pump system

Possibility to add of solvents / additives or other  
type of amendments to increase efficiency of  
the foam fractionation process

Injection is performed straight into the Foam

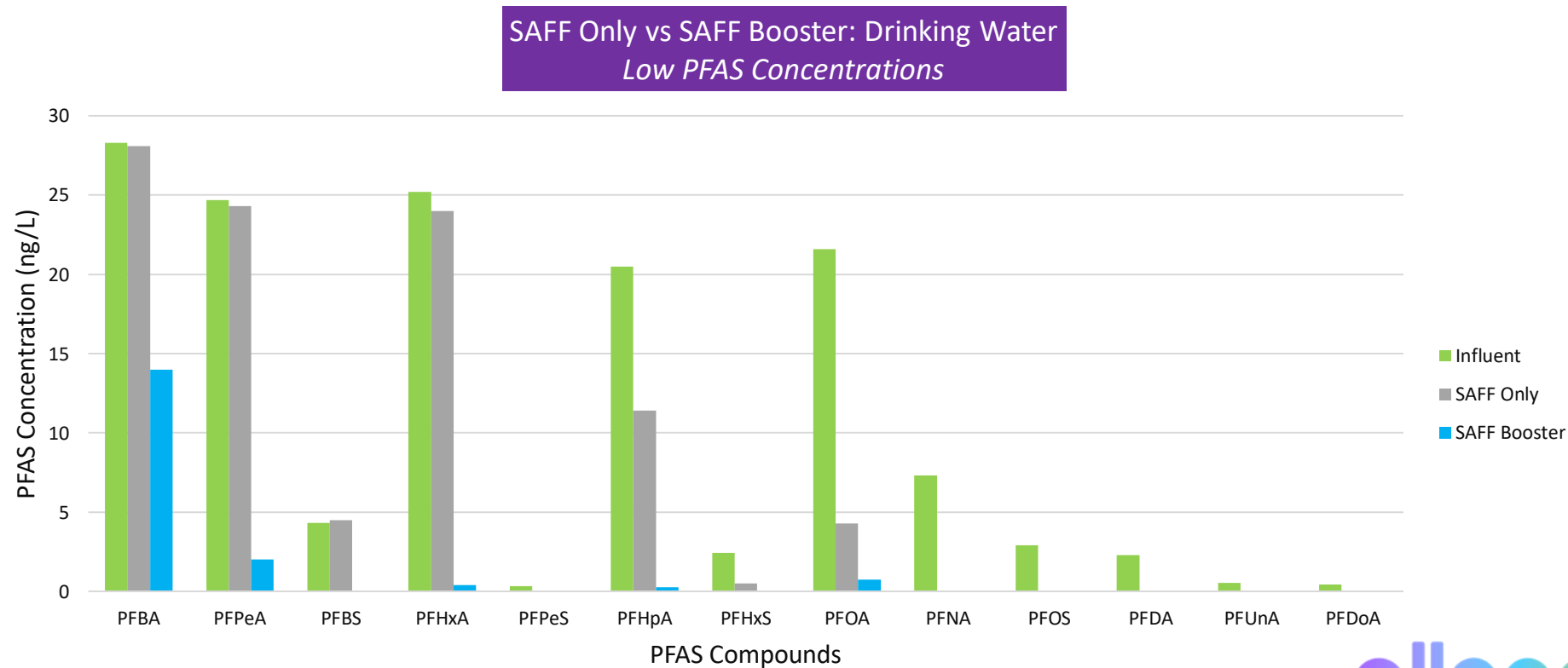


Figure 20: Dosing tank and pump



# The race to find additives for short chain removal is on!

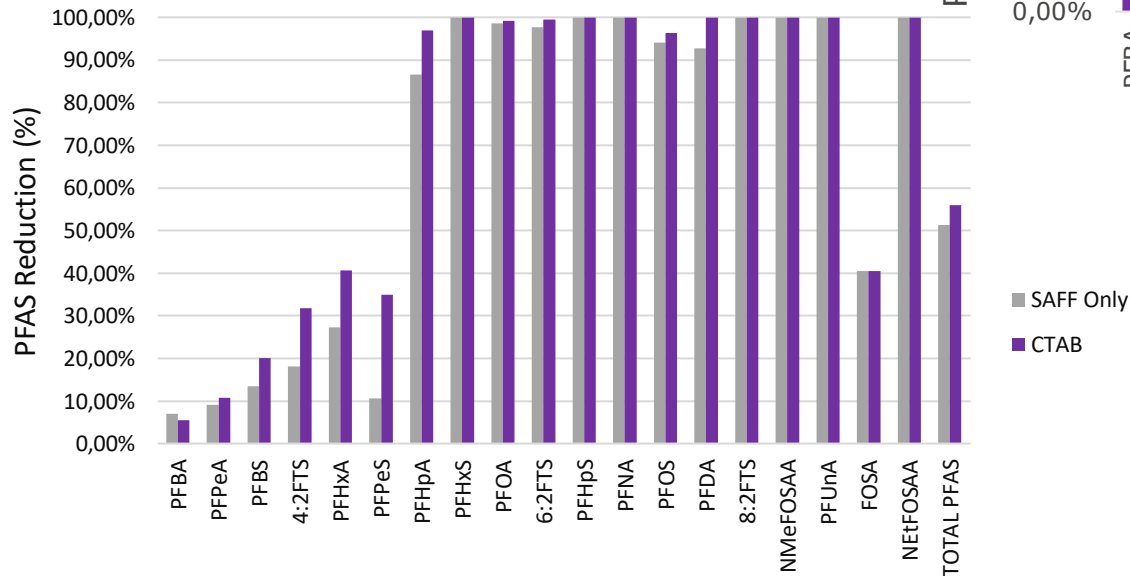
Possibilities with amendments by bio-tech team Allonnia



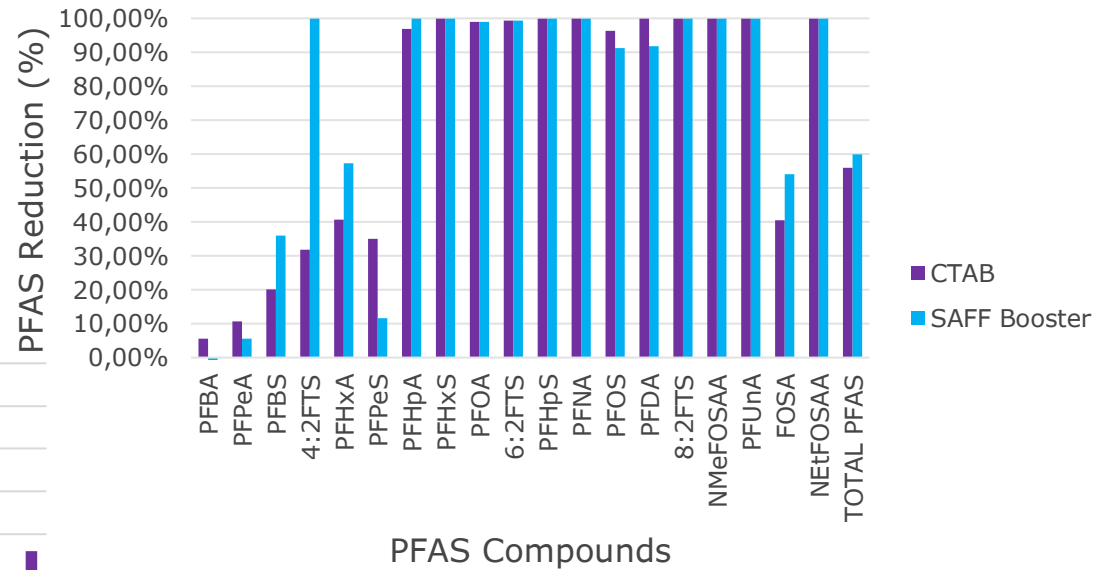


# The race to find additives for short chain removal is on!

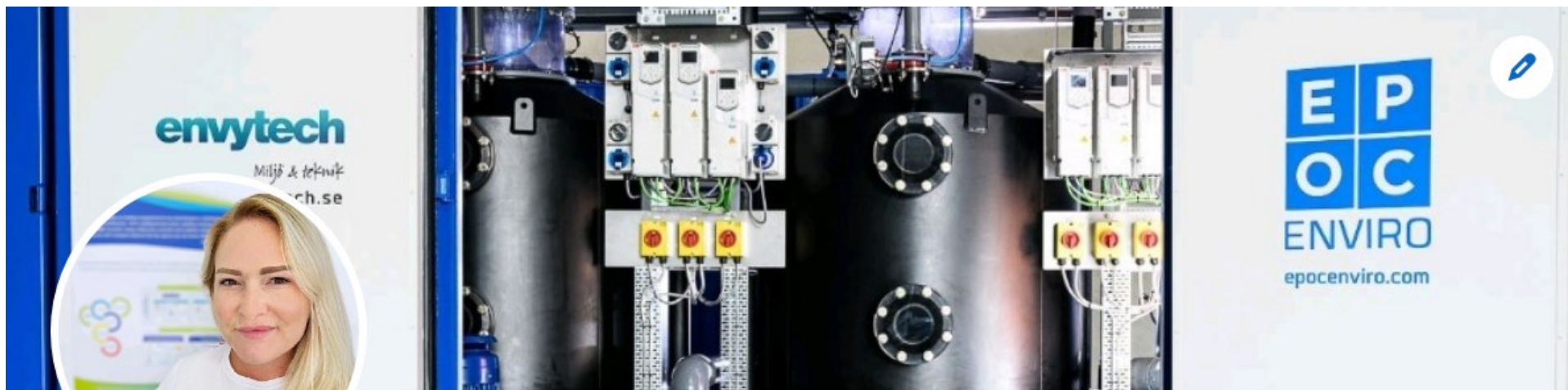
SAFF Only vs CTAB: Landfill Leachate



CTAB vs SAFF Booster - Landfill Leachate



För den senaste informationen om tekniker och lösningar för PFAS.  
Följ mig och projektet på LinkedIn



**Helena Hinrichsen** (Passionista, PFASionista)

Founder, Chief Commercial Officer PFAS, Envytech Solutions AB

Talks about #pfas, #leachate, #horizon2020, and #watertreatment

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 Envytech Solutions AB

 Griffith University



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