





Treatment of PFAS contaminated water with SAFF - Surface Active Foam Fractionation

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Envytech Solutions AB

SAFF – Surface Active Foam Fractionation



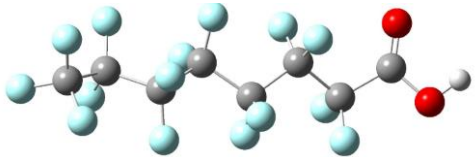
Quick repeat of the nature of PFAS molecules

PFAS - So many, So similar, yet so different

- **Precursors**
  Species of perflourinated substances and polymers that becomes e.g. PFBA, PFOA when oxidized

- **Short chains– more soluble, harder to catch**
  - **PFCAs** with 7 or less carbon atoms, or 6 or less perflourinated carbon atoms
  - **PFSAs** with 5 or less less carbon atoms, or 5 or less perflourinated carbon atoms

- **Long chains – Less soluble, easier to catch**
  - S.k. **PFCAs** with 7 or more carbon atoms, or 8 or more perflourinated carbon atoms
  - S.k. **PFSAs**, with 6 or more carbon atoms, or 6 or more perflourinated carbon atoms



PFAS – Quick repeatof the nature of PFAS molecules

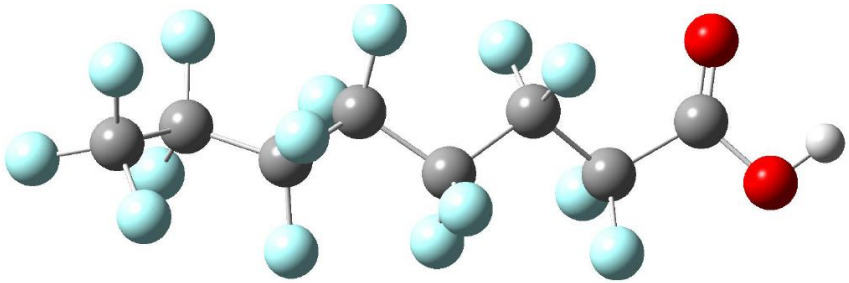
Perflourinated substances has:

Hydrophilic head – Head loves water

Hydrophobic tail – Tail hates water

➔ The bubble becomes the perfect environment





SAFF – Surface Active Foam Fractionation

➔ **SAFF uses the air bubbles physiochemistry as the perfect environment for PFAS to get them out of solution and into a removable foam**





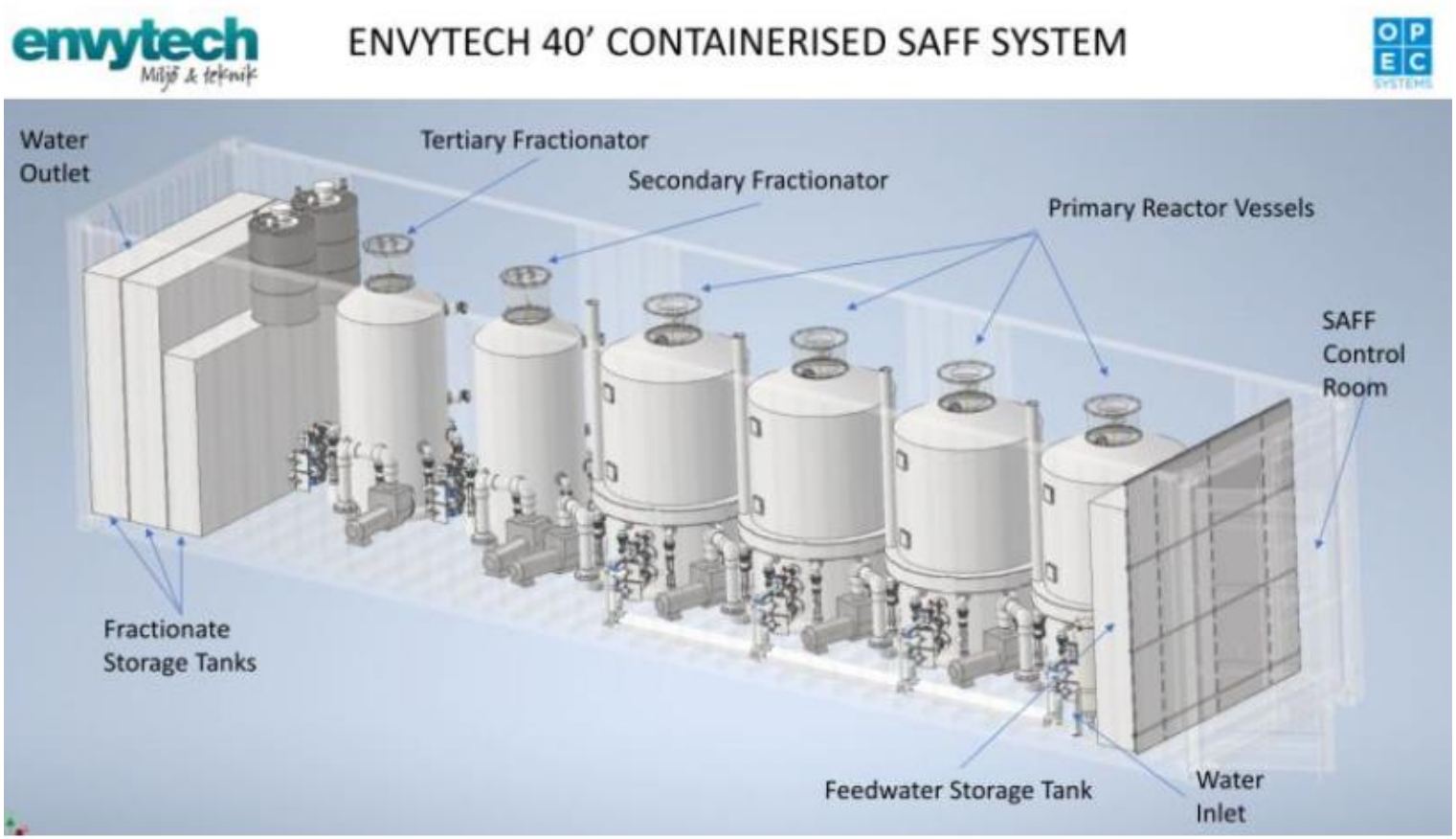




How its done:

- **Let bubbels bubbel in a column**
  - Use the expansion of the volume by the bubbles to overflow a chamber - as well as help out with a last "push at the end"
  - Release the treated water !
- **Concentrate the foam in a second step**
- **Concentrate the "foamed foam" in a third step**

SAFF – Surface Active Foam Fractionat









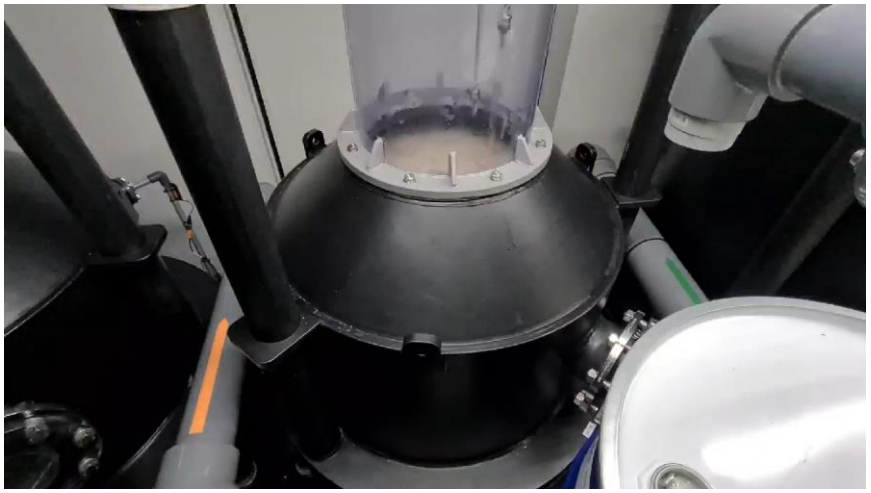
SAFF – Surface Active Foam Fractionation



Primary Fractionation: 10 x concentrationen

SAFF – Surface Active Foam Fractionation





Secondary Fractionation:
1 500 x concentrationen

Tertiery Fractionation:
50 – 200 x Concentration

Total concentration increase: 500 - 200 000 x concentration

SAFF – Surface Active Foam Fractionation

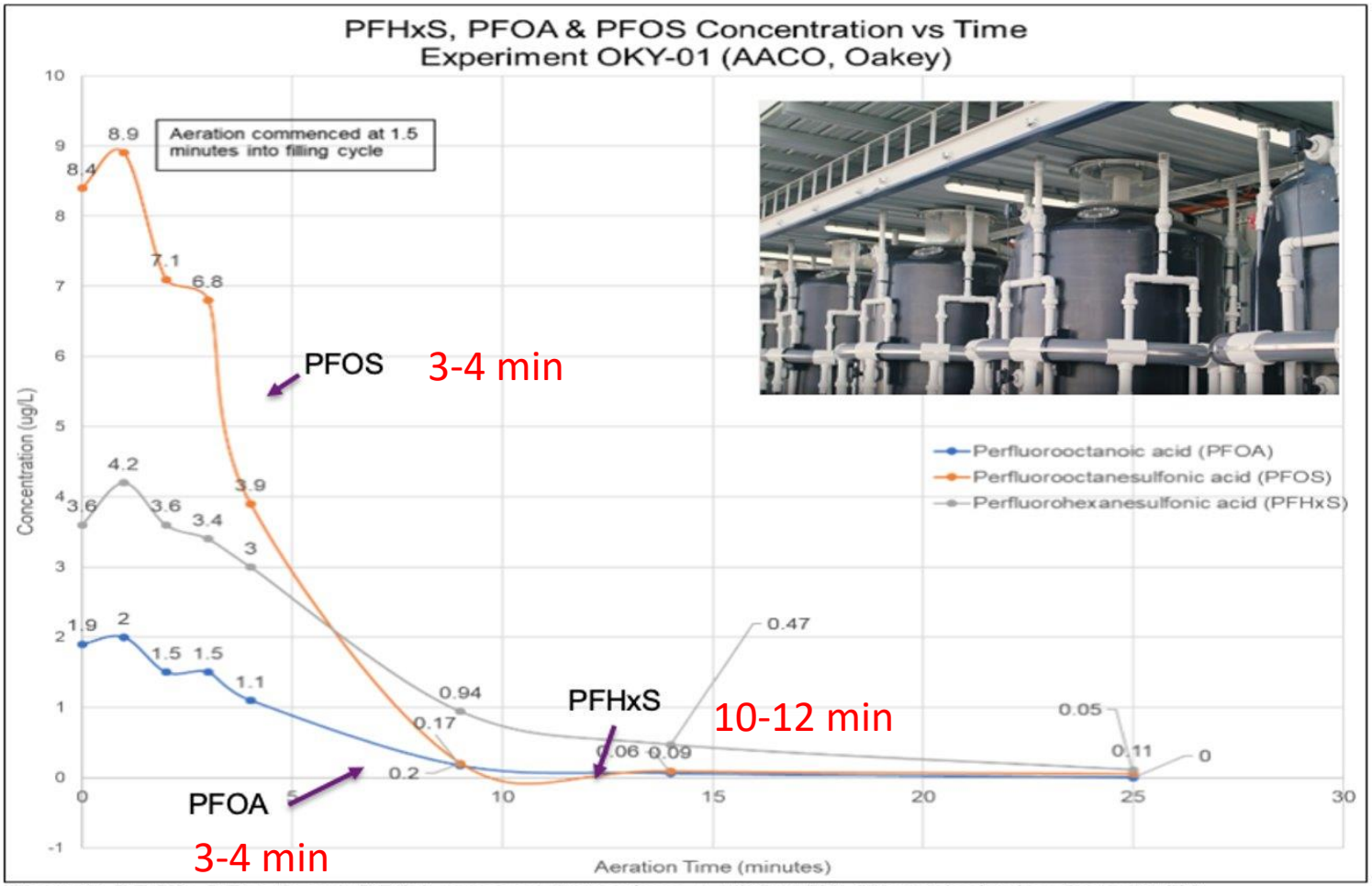


Chart-3: PFOS, PFHxS and PFOA removal Rates from AACO WTP (Commissioning Data 2019).

Substance	Estimated optimal treatment time per sunstance (min)
PFPrS	60
PFBA	60
PFBS	45
PFPeA	60
PFPeS	45
PFHxA	60
PFHxS	25
PFHpA	30
PFOA	15
PFOS	15
PFOSA	25
PFNA	25
PFDA	20
6:2FTS	20
8:2FTS	15

SAFF Ref Project (full scale): Oakey

Results Oakey, Australia

- 2 years of operation
- 50 000 m3 treated GW
- Target: 70 ng/l
  - PFOS
  - PFOA
  - PFHxS
- No exceedence in 2 years
- 10 liter of PFAS conc (waste)



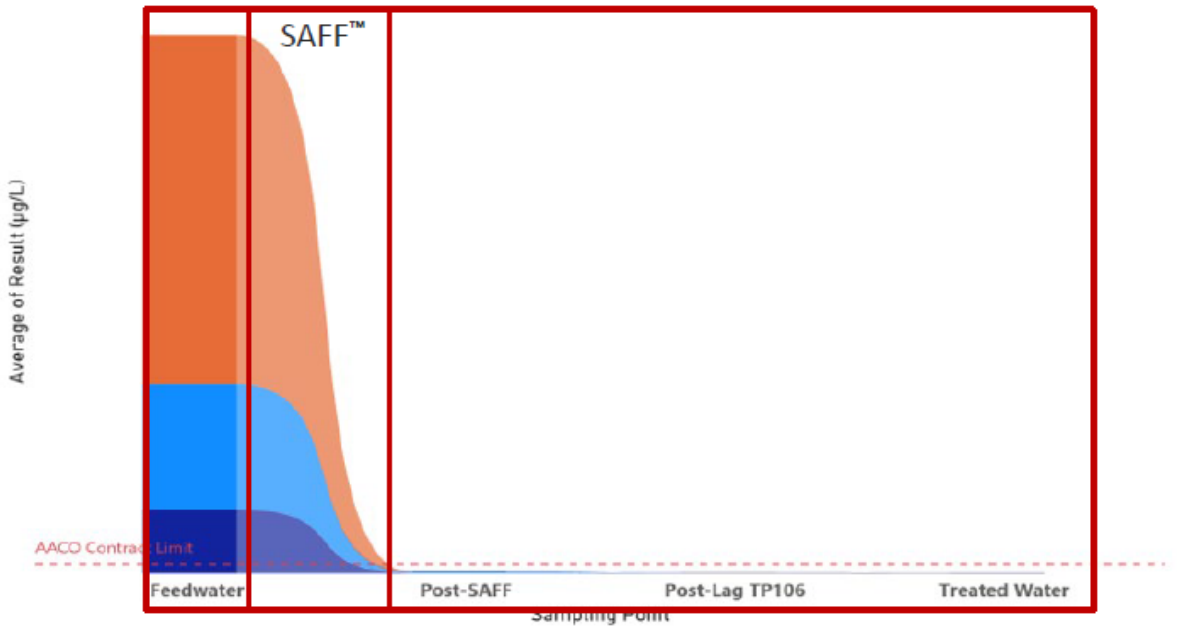
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SAFF Ref Project (full scale): Oakey

Pre- and Post- SAFF™ PFAS Signature

Job: 18038MPX | Lab Name: MGT | Level: Standard / Trace / Ultratrace | Reportable: Select all, 10:2 FTS (µg/L), 4:2 FTS (µg/L), 6:2 FTS (µg/L) | Sampling Point: (Blank), Feedwater, Post-SAFF, Post-GAC (TOC)

Average Total Detectable PFAS Breakdown



Reportable	Feedwate	Post-SAFF	Post-Lag TP106	Treated
PFHxS (µg/L)	0.965	0.010	0.002	0.002
PFOA (µg/L)	0.495	0.002	0.002	0.002
PFOS (µg/L)	2.700	0.002	0.002	0.002

KEY POINTS

1. Heavy Lifter
2. 100% Removal L-Chains
3. >85% Bulk PFAS Reduction (source zone)
   50-60% down-gradient
4. Limits Polishing
5. CAPEX/OPEX fixed cf [PFAS]
6. Low OPEX
7. Scalable, Modular, Stackable
8. Sustainable

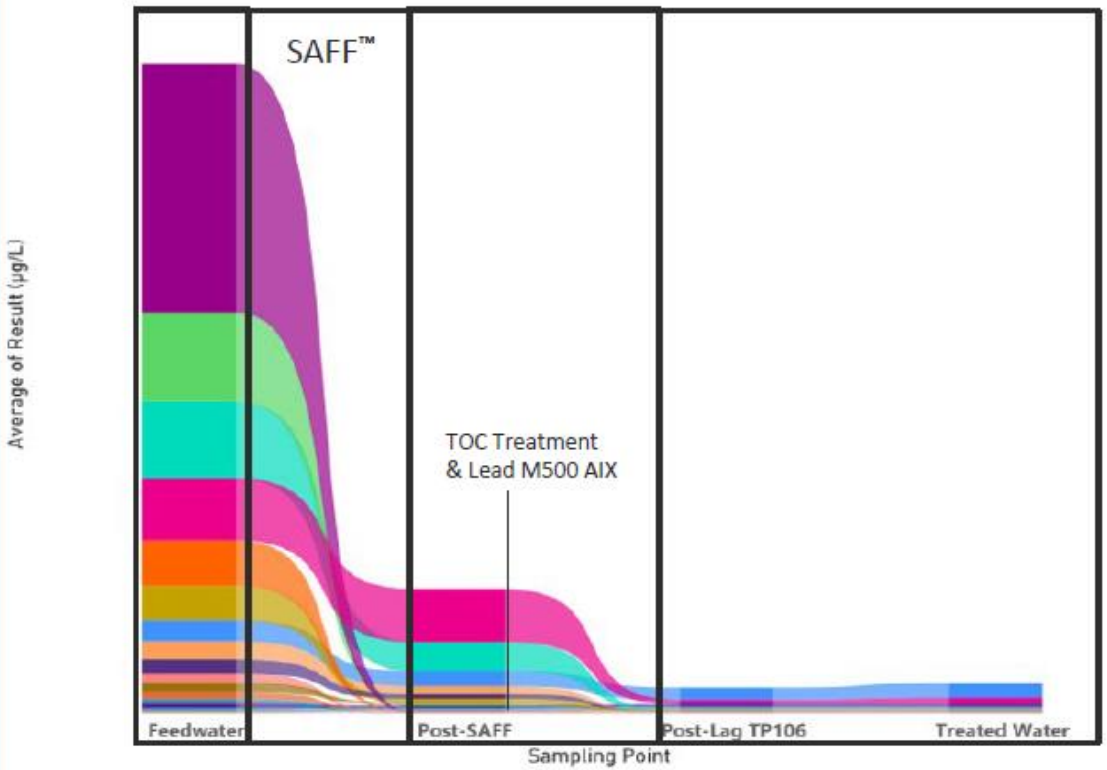
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SAFF Ref Project (full scale): Oakey

Monitoring 30+ PFAS Compounds (AACO)

Job: 18038MPX | Lab Name: MGT | Level: Trace | Reportable: 10:2 FTS (µg/L), 4:2 FTS (µg/L), 6:2 FTS (µg/L) | Sampling Point: Feedwater, Post-SAFF | Sampled Time: 10/16/2019 – 1/22/2020

Average Total Detectable PFAS Breakdown



Reportable	Feedwate	Post-SAFF	Post-Lag TP106	Treated
10:2 FTS (µg/L)	0.010	0.010	0.010	0.010
4:2 FTS (µg/L)	0.010	0.010	0.010	0.010
6:2 FTS (µg/L)	0.086	0.005	0.005	0.005
8:2 FTS (µg/L)	0.026	0.010	0.010	0.010
EtFOSA (µg/L)	0.005	0.005	0.005	0.005
EtFOSAA (µg/L)	0.005	0.005	0.005	0.005
EtFOSE (µg/L)	0.005	0.005	0.005	0.005
FOSA (µg/L)	0.005	0.005	0.005	0.005
MeFOSA (µg/L)	0.005	0.005	0.005	0.005
MeFOSAA (µg/L)	0.005	0.005	0.005	0.005
MeFOSE (µg/L)	0.005	0.005	0.005	0.005
PFBA (µg/L)	0.230	0.163	0.140	0.160
PFBS (µg/L)	0.198	0.082	0.002	0.002
PFDA (µg/L)	0.003	0.001	0.001	0.001
PFDoDA (µg/L)	0.001	0.001	0.001	0.001
PFDS (µg/L)	0.001	0.001	0.001	0.001
PFHpA (µg/L)	0.368	0.047	0.002	0.002
PFHpS (µg/L)	0.102	0.002	0.002	0.002
PFHxA (µg/L)	0.835	0.317	0.003	0.003
PFHxS (µg/L)	0.965	0.010	0.002	0.002
PFNA (µg/L)	0.048	0.001	0.001	0.001
PFNS (µg/L)	0.010	0.001	0.001	0.001
PFOA (µg/L)	0.495	0.002	0.002	0.002
PFOS (µg/L)	2.700	0.002	0.002	0.002
PFPeA (µg/L)	0.675	0.573	0.046	0.068
PFPeS (µg/L)	0.153	0.058	0.002	0.002
PFPrS (µg/L)	0.098	0.014	0.001	0.001
PFTeDA (µg/L)	0.001	0.001	0.001	0.001
PFTrDA (µg/L)	0.001	0.001	0.001	0.001
PFUnDA (µg/L)	0.001	0.001	0.001	0.001

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SAFF Ref Project (full scale): Oakey

OPEC Systems Prediction model GW (?)

PFAS	Removal %
PFBA	21%
PFPeA	24%
PFHxA	20%
PFHpA	67%
PFOA	100%
PFNA	100%
PFDA	100%
PFBS	22%
PFHxS	99%
PFOS	100%
6:2 FTS	100%

miniSAFF – Bench scale testing unit



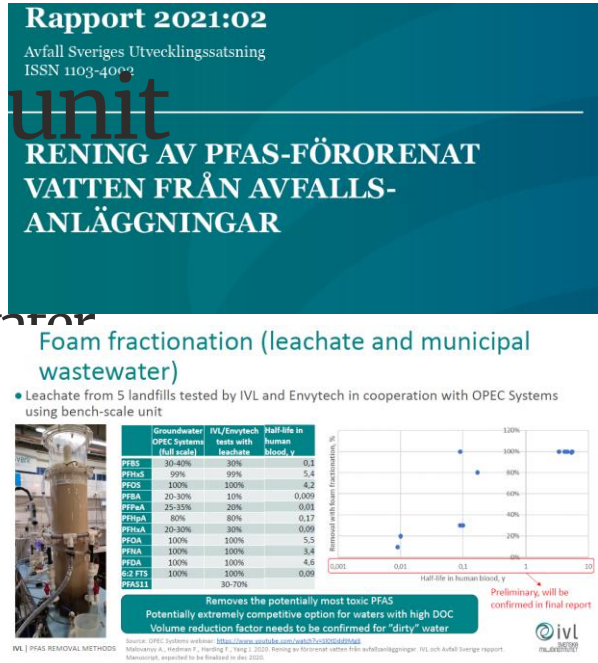
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miniSAFF – Bench scale testing unit

IVL test for Avfall Sverige Rapport 2021:02
Foam Fractionation (leachate and municipal waste water)

Leachate from 5 landfills tested by IVL and Envytech

Ämne	Antal kolatomer	OPEC Prediction model GW (full scale)	IVL/Envytech tests with leachate	Half life in Human body (years)
PFDA (Perfluordekansyra)	C10	100%	100%	5,6
PFNA (Perfluornonansyra)	C9	100%	100%	2,8
6:2 FTS (Fluortelomer sulfonat)	C8	100%	100%	0,08
PFOA (Perfluoroktansyra)	C8	100%	100%	3,3
PFOS (Perfluoroktansulfonsyra)	C8	100%	100%	5,7
PFHpA (Perfluorheptansyra)	C7	80%	80%	0,44
PFHxS (Perfluorhexansulfonsyra)	C6	99%	99%	9,9
PFHxA (Perfluorhexansyra)	C6	20-30%	30%	0,06
PFPeA (Perfluorpentansyra)	C5	25-35%	20%	0,1
PFBA (Perfluorbutansyra)	C4	20-20%	10%	0,009
PFBS (Perfluorbutansulfonsyra)	C4	30-40%	30%	0,107
Summa PFAS		30-70%		



miniSAFF – Bench scale testing unit

Private industrial site
Run off water.
Lots of ”secret ingredients” from industry processes, ”Medium” PFAS levels

Provpunkt		C industry	C industry		
Provets märkning	längd kolkedja	X19 0min	X19 15min	% removal 15 min	OPEC Model
PFDA (Perfluordekansyra) (ng/l)	C10	<10	<1,0	bdl	100%
PFNA (Perfluornonansyra) (ng/l)	C9	<10	<1,0	bdl	100%
6:2 FTS (Fluortelomer sulfonat) (ng/l)	C8	1300	300	77%	100%
PFOA (Perfluoroktansyra) (ng/l)	C8	280	88	69%	100%
PFOS (Perfluoroktansulfonsyra) (ng/l)	C8	4100	260	94%	100%
PFHxS (Perfluorhexansulfonsyra) (ng/l)	C7	770	350	55%	97%
PFHpA (Perfluorheptansyra) (ng/l)	C6	110	83	25%	67%
PFHxA (Perfluorhexansyra) (ng/l)	C6	500	410	18%	20%
PFPeA (Perfluorpentansyra) (ng/l)	C5	460	500	0%	24%
PFBA (Perfluorbutansyra) (ng/l)	C4	100	99	1%	21%
PFBS (Perfluorbutansulfonsyra) (ng/l)	C4	76	79	0%	22%
Summa PFAS SLV 11 (ng/l)		7700	2200	71%	

miniSAFF – Bench scale testing unit

Private Industrial Site
Waste water – Before MBBR
Low in susp. Particles, high in DOC. Low pH. Low in PFAS

Provets märkning	längd kolkedja	C industry	C industry	INRB Results 10 min	
		INRB - 0min	INRB - 10min	% removed	OPEC Model
PFDA (Perfluordekansyra) (ng/l)	C10	<1,0	<1,0	na	100%
PFNA (Perfluornonansyra) (ng/l)	C9	<1,0	<1,0	na	100%
6:2 FTS (Fluortelomer sulfonat) (ng/l)	C8	14	1	93%	100%
PFOA (Perfluoroktansyra) (ng/l)	C8	5,2	1	81%	100%
PFOS (Perfluoroktansulfonsyra) (ng/l)	C8	69	1,3	98%	100%
PFHxS (Perfluorhexansulfonsyra) (ng/l)	C7	9,8	1	90%	97%
PFHpA (Perfluorheptansyra) (ng/l)	C6	1,6	1	38%	67%
PFHxA (Perfluorhexansyra) (ng/l)	C6	3,6	1	72%	20%
PFPeA (Perfluorpentansyra) (ng/l)	C5	3,7	1,6	57%	24%
PFBA (Perfluorbutansyra) (ng/l)	C4	<3,0	<3,0	na	21%
PFBS (Perfluorbutansulfonsyra) (ng/l)	C4	<1,0	<1,0	na	22%
Summa PFAS SLV 11 (ng/l)		107	8	97%	
TOC (mg/l)	1200				
DOC (mg/l)	1200				
pH ()	3,8				
TOC (mg/l)	1200				
DOC (mg/l)	1200				
pH ()	3,8				

miniSAFF – Bench scale testing unit

Private Industrial Site
Waste water – After MBBR
High in susp. sarticles, low in DOC. Averge pH. Low in PFAS

Provets märkning	längd kolkedja	UTRB - 0min	UTRB - 30min	%Removal 30 min
PFDA (Perfluordekansyra) (ng/l)	C10	<1,0	<1,0	bdl
PFNA (Perfluornonansyra) (ng/l)	C9	<1,0	<1,0	bdl
6:2 FTS (Fluortelomer sulfonat) (ng/l)	C8	<1,0	<1,0	bdl
PFOA (Perfluoroktansyra) (ng/l)	C8	2,4	<1,0	58%
PFOS (Perfluoroktansulfonsyra) (ng/l)	C8	22	3,1	86%
PFHxS (Perfluorhexansulfonsyra) (ng/l)	C7	5,3	<1,0	81%
PFHpA (Perfluorheptansyra) (ng/l)	C6	<1,0	<1,0	bdl
PFHxA (Perfluorhexansyra) (ng/l)	C6	7,1	<1,0	86%
PFPeA (Perfluorpentansyra) (ng/l)	C5	4,7	3,3	30%
PFBA (Perfluorbutansyra) (ng/l)	C4	5	5,7	0%
PFBS (Perfluorbutansulfonsyra) (ng/l)	C4	1,9	<1,0	47%
Summa PFAS SLV 11 (ng/l)		48	12,1	76%
TOC (mg/l)	700	580		
DOC (mg/l)	300	260		
pH ()	7,6	7,7		

miniSAFF – Bench scale testing unit

Private Industrial Site
Ground water
Low in susp. particles, DOC & TOC. High in PFAS

Provtagningsdag		2021-02-15	2021-02-15	%Removal miniSAFF	OPEC Systems Predictive Model GW
Provpunkt		Industry GW	Industry GW		
Provets märkning	längd kolkedja	MW 323 Untreated 0 min	MW 323 Treated 20 min		
PFDA (Perfluordekansyra) (ng/l)	C10	<10	<10	bdl	100%
PFNA (Perfluornonansyra) (ng/l)	C9	<10	<10	bdl	100%
6:2 FTS (Fluortelomer sulfonat) (ng/l)	C8	22	<10	55%	100%
PFOA (Perfluoroktansyra) (ng/l)	C8	800	95	88%	100%
PFOS (Perfluoroktansulfonsyra) (ng/l)	C8	22 000	400	98%	100%
PFHxS (Perfluorhexansulfonsyra) (ng/l)	C7	5 000	1 200	76%	97%
PFHpA (Perfluorheptansyra) (ng/l)	C6	200	96	52%	67%
PFHxA (Perfluorhexansyra) (ng/l)	C6	670	530	21%	20%
PFPeA (Perfluorpentansyra) (ng/l)	C5	150	110	27%	24%
PFBA (Perfluorbutansyra) (ng/l)	C4	<20	<20	bdl	21%
PFBS (Perfluorbutansulfonsyra) (ng/l)	C4	350	210	40%	22%
Summa PFAS SLV 11 (ng/l)		29 000	2 600	91%	
DOC (mg/l)	< 2,0				
TOC (mg/l)	< 2,0				

SAFF Ref Project (full scale): Oakey

OPEC Systems Prediction model ~~GW~~ ALL waters

PFAS	Removal %
PFBA	21%
PFPeA	24%
PFHxA	20%
PFHpA	67%
PFOA	100%
PFNA	100%
PFDA	100%
PFBS	22%
PFHxS	99%
PFOS	100%
6:2 FTS	100%

Welcome to Telge Återvinning



Telge Återvinning – Site specifics

Summary of concentrations for organic and inorganic contaminants and biological and chemical parameters

Ämne	Enhet	Riktvärde	Jan	Feb	Mars	April	Maj	J
Turbiditet	FNU			76			20	
Färg (410 nm)	mg Pt/l			620			190	
pH				7,5	6,9	7,5	7,8	
Temperatur vid pH-mätning	°C			22,9	22,2	22,4	22,8	
Alkalinitet	mg HCO3/l			910	840	770	590	
Konduktivitet	mS/m			1300			1200	
Klorid	mg/l			3200	3600	3100	3000	
Sulfat	mg/l			270	210	350	360	
TOC	mg/l			80			72	
Ammonium-nitrogen (NH4-N)	mg/l			130	50	130	100	
Nitrat+Nitrit nitrogen	mg/l			15			19	
Fosfor P	mg/l			4,2			1,2	
Kväve N	mg/l			170			140	
Natrium Na (uppslutet)	mg/l			1200			1400	
Kalium K (uppslutet)	mg/l			670			810	
Arsenik As (uppslutet)	mg/l			0,0028			0,0029	
Bly Pb (uppslutet)	mg/l	0,05		0,0005	0,0005	0,0005	< 0.00050	
Kadmium Cd (uppslutet)	mg/l	0,005		0,0001	0,0001	0,0001	< 0.00010	
Koppar Cu (uppslutet)	mg/l	0,2		0,01	0,0083	0,016	0,011	
Krom Cr (uppslutet)	mg/l	0,05		0,0068	0,00091	0,011	0,018	
Kvicksilver Hg (uppslutet)	mg/l	0,005		0,0001	0,0001	0,0001	< 0.00010	
Nickel Ni (uppslutet)	mg/l	0,05		0,017	0,0065	0,021	0,029	
Silver Ag (uppslutet)	mg/l	0,2		0,00005	0,00005	0,00005	0,000079	
Zink Zn (uppslutet)	mg/l	0,2		0,022	0,026	0,037	0,024	
Oljeindex	mg/l	50		0,1	0,1	0,1	0,1	

Substance		Average concentrations
Suspended Particles	mg/l	75-300
TOC	mg/l	69-100
DOC	mg/l	45-81
PFOA	mg/l	250-300
PFOS	mg/l	84-120

Telge Återvinning – Site specifics

Algae Analyze results

The sample contained a large number of very irregular, yellow and green coloured conglomerate of particles. The conglomerate seemed to be made up from a gelatinous mass with a larg amount of very fine particles. No distinct organisms could be identified in these conglomerats.

The sample also contained one cell zooflagellates (protozoans)which are common in environments with a vast amount of easily digested, organic material. One example of a zooflagellate that was commonly found in the sample was *Bodo sp*

Report by Pelagia Nature & Environment AB



Telge Återvinning – Site specifics

Data summary for concentrations of PFOA, PFOS, TOC, DOC and suspended particles
May to September 2019

		19-05-21	19-05-22	19-05-23	19-05-24	19-05-25	19-05-26	19-05-27	Average
Suspended Particles	mg/l	75	75	120		110	150	300	**75-300**
TOC	mg/l	100	100	87	69	75	87	82	**69-100**
DOC	mg/l	81		74	52	45	55	53	**45-81**
PFOA	ng/l	280		280	280	300	250	250	**250-300**
PFOS	ng/l	94		100	110	120	78	84	**84-120**

Verdict: Scary, really comlex ”water” with a large amount of challenges for traditional treatment methods, but not for SAFF. Lets do it!



Telge Återvinning – Bench scale test

Results from test with miniSAFF

Ämne	Untreated miniSAFF	% Removal miniSAFF 15 min
6:2 FTS (Fluortelomer sulfonat)	1,1	73%
PFBA (Perfluorbutansyra)	90	0%
PFBS (Perfluorbutansulfonsyra)	36	0%
PFDA (Perfluordekansyra)	3	80%
PFHpA (Perfluorheptansyra)	54	95%
PFHxA (Perfluorhexansyra)	130	8%
PFHxS (Perfluorhexansulfonsyra)	28	99%
PFNA (Perfluornonansyra)	23	97%
PFOA (Perfluoroktansyra)	150	100%
PFOS (Perfluoroktansulfonsyra)	190	98%
PFPeA (Perfluorpentansyra)	150	0%



Telge Återvinning – Site specifics



Treatment with activated carbon due to Covid-19

- Automized chemical dosge of special algae flocculant and precipitation
- Two step mixertank
- Lamella clarifier HB40R
- 38 m3 sedimentation tank
- 1500 kg (3 m3) activated carbon as ”biofilter” (Filtrasorb 400)
- 1500 kg (3 m3) activated carbon for PFAS removal (filtrasorb 400)
- Time before breakthrough: 4 days of <10 m3/h

Telge Återvinning – The Arrival



Telge Återvinning – Results

Comparison of results from miniSAFF and Full scale SAFF40

Ämne	Removal rate % Predictive Model	Removal rate % Telge miniSAFF 15 min	Removal rate % Telge SAFF40 19 min	Removal rate % Telge SAFF40 19 min	Removal rate % Telge SAFF40 18 min	Removal rate % Telge SAFF40 18 min	Average % Removal rate
			2021-01-28	2021-02-17	2021-03-13	2021-03-20	
6:2 FTS (Fluortelomer sulfonat)	100%	0%	97%	96%	98%	98%	97%
PFBA (Perfluorbutansyra)	21%	99%	15%	0%	3%	0%	4%
PFBS (Perfluorbutansulfonsyra)	22%	98%	22%	23%	9%	87%	26%
PFDA (Perfluordekansyra)	100%	0%	72%	29%	63%	79%	66%
PFHpA (Perfluorheptansyra)	67%	8%	97%	99%	97%	99%	94%
PFHxA (Perfluorhexansyra)	20%	95%	49%	45%	31%	91%	50%
PFHxS (Perfluorhexansulfonsyra)	97%	100%	98%	98%	98%	98%	98%
PFNA (Perfluornonansyra)	100%	73%	98%	97%	98%	99%	98%
PFOA (Perfluoroktansyra)	100%	0%	100%	100%	100%	100%	100%
PFOS (Perfluoroktansulfonsyra)	100%	97%	100%	99%	99%	100%	99%
PFPeA (Perfluorpentansyra)	24%	80%	23%	15%	0%	60%	13%

Telge Återvinning – Results

Diving into the concentrations

Ämne	Untreated	Treated	Removal rate % Telge SAFF40 19 min	Untreated	Treated	Removal rate % Telge SAFF40 19 min	Untreated	Treated	Removal rate % Telge SAFF40 19 min	Untreated	Treated	Removal rate % Telge SAFF40 18 min	Untreated	Treated	Removal rate % Telge SAFF40 18 min
	100 m3	100m3	100 m3	300 m3	300 m3	300 m3	1000m3	1000m3	1000m3	2295 m3	2295 m3	2295 m3	3270 m3	3270 m3	3270 m3
	2021-01-28	2021-01-28	2021-01-28	2021-02-10	2021-02-10	2021-02-10	2021-02-17	2021-02-17	2021-02-17	2021-02-23	2021-02-23	2021-02-23	2021-02-27	2021-02-27	2021-02-27
6:2 FTS (Fluortelomer sulfonat)	34	<1,0	97%	27	<1,0	96%	25	1	96%	39	<1	97%	45	1	98%
PFBA (Perfluorbutansyra)	270	230	15%	260	260	0%	310	310	0%	330	300	9%	310	330	0%
PFBS (Perfluorbutansulfonsyra)	96	75	22%	120	120	0%	130	100	23%	110	98	11%	170	97	43%
PFDA (Perfluordekansyra)	9,7	2,7	72%	2,9	<1,0	66%	1,4	1	29%	2,3	<1	57%	2,4	1	58%
PFHpA (Perfluorheptansyra)	120	3,9	97%	120	31	74%	140	1,5	99%	160	3,1	98%	450	1,7	100%
PFHxA (Perfluorhexansyra)	390	200	49%	430	360	16%	470	260	45%	640	370	42%	1100	340	69%
PFHxS (Perfluorhexansulfonsyra)	65	<1,0	98%	60	1,7	97%	42	1	98%	64	<1	98%	84	1	99%
PFNA (Perfluornonansyra)	76	1,3	98%	49	<1,0	98%	34	1	97%	43	<1	98%	54	1	98%
PFOA (Perfluoroktansyra)	350	1,5	100%	340	1,8	99%	280	1,2	100%	390	5,7	99%	510	1	100%
PFOS (Perfluoroktansulfonsyra)	310	<1,0	100%	110	2,1	98%	84	1,1	99%	100	2,5	98%	110	1	99%
PFPeA (Perfluorpentansyra)	390	300	23%	430	400	7%	480	410	15%	510	520	0%	590	460	22%
PFAS 11	2100	810	61%	1900	1200	37%	2000	1100	45%	2400	1300	46%	3400	1200	65%

SAFF – Swedavia Trial

Swedavia Airports

Treatment of PFAS contaminated water from a collection dam within the Arlanda Airport with SAFF40 (full scale).

The experiment was performed on a total of 40 m3 of water. The purpose of the experiment was to evaluate the effect of SAFF technology on current water.







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SAFF – Swedavia Trial

Swedavia Airports

Ämne	Enhet	Antal kolatomer	Obehandlat 0 min	Behandlat 20 min	Behandlat 20min + skum	Reningseffekt % ej tillsatts av skum	Reningseffekt % tillsats av skum	OPEC Model
PFDA (Perfluordekansyra)	ng/l	C10	0,33	<0,30	<0,30	100%	100%	100%
PFNA (Perfluornonansyra)	ng/l	C9	3	0,53	<0,30	82%	100%	100%
6:2 FTS (Fluortelomer sulfonat)	ng/l	C8	36	0,37	<0,30	99%	100%	100%
PFOA (Perfluoroktansyra)	ng/l	C8	83	3,7	1,4	96%	98%	100%
PFOS (Perfluoroktansulfonsyra)	ng/l	C8	710	4,1	2,9	99%	100%	100%
PFHpA (Perfluorheptansyra)	ng/l	C7	46	12	9,5	74%	79%	80%
PFHxS (Perfluorhexansulfonsyra)	ng/l	C6	220	7	2,2	97%	99%	99%
PFHxA (Perfluorhexansyra)	ng/l	C6	95	92	96	3%	0%	99%
PFPeA (Perfluorpentansyra)	ng/l	C5	120	150	150	0%	0%	30%
PFBA (Perfluorbutansyra)	ng/l	C4	22	51	43	0%	0%	25%
PFBS (Perfluorbutansulfonsyra)	ng/l	C4	25	30	27	0%	0%	30%
Summa PFAS	**ng/l %**		**1360**	**351**	**332**	**74%**	**76%**	

Ämne	Enhet	Antal kolatomer	Obehandlat 0 min	Behandlat 20 min	Behandlat 20min + skum	Reningseffekt % ej tillsatts av skum	Reningseffekt % tillsats av skum	OPEC Model
PFDA (Perfluordekansyra) (TOP)	ng/l	C10	0,67	<0,30	0,34	55%	49%	100%
PFNA (Perfluornonansyra) (TOP)	ng/l	C9	3,7	0,62	0,72	83%	81%	100%
6:2 FTS (Fluortelomer sulfonat) (TOP)	ng/l	C8	<0,30	<0,30	<0,30	0%	0%	100%
PFOA (Perfluoroktansyra) (TOP)	ng/l	C8	71	2	3,4	97%	95%	100%
PFOS (Perfluoroktansulfonsyra) (TOP)	ng/l	C8	650	2,2	4	100%	99%	100%
PFHpA (Perfluorheptansyra) (TOP)	ng/l	C7	38	8,4	11	78%	71%	80%
PFHxS (Perfluorhexansulfonsyra) (TOP)	ng/l	C6	220	2,1	6,3	99%	97%	99%
PFHxA (Perfluorhexansyra) (TOP)	ng/l	C6	210	80	91	62%	57%	99%
PFPeA (Perfluorpentansyra) (TOP)	ng/l	C5	190	130	130	32%	32%	30%
PFBA (Perfluorbutansyra) (TOP)	ng/l	C4	86	52	56	40%	35%	25%
PFBS (Perfluorbutansulfonsyra) (TOP)	ng/l	C4	22	27	28	0%	0%	30%
Summa PFAS (TOP)	**ng/l**		**1491**	**304**	**331**	**80%**	**78%**	

SAFF – Summery of system capabilities

Benefits

The system is robust - works without reduced effectiveness regardless if water contains large amounts of suspended material, contaminants of various kinds and / or biological substances

Works regardless of concentrations - high concentrations no problem, only advantage
Works better in colder water and is not pH sensitive.

Minimal need for pre-treatment system

Proven / about to be confirmed to work for microplastics

Possibility: Removes all substances with a Langmuir constant >1x10-6. Includes pharmaceuticals, nonylophenol and we are investigating what else!

Limitations

Works > 99,9% on PFAS with carbon chains longer than C6 (eg PFOS, PFOA, PFHxS, 6: 2)

Works 25-50% on PFAS with carbon chains shorter than C6 (eg PFBA, PFPeA, PFHxA

Remaining short PFAS can be polished using ion exchangers. SAFF minimizes the amount of ion exchanger needed, increases the surface area for shorter chain PFAS

Telge Återvinning – Results

Wonderful results!
But how much does it cost ?

Installation:	40 h service technician. Included in rental at long time hire.
Electricity:	0,7 kwh / m3 treated
Service:	8h service technician per month
Waste (from leachate):	< 3 m3 / year at flows of < 20 m3/h (4500 SEK/m3 @SAKAB exkl. transport
Possibility!	No waste – ”Closed loop” possibility within 6-12 months. Cooperations with destruction technology producers on its way