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Impact of cumulative sludge release from OWWTS

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NOWRA, 2022

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Introduction

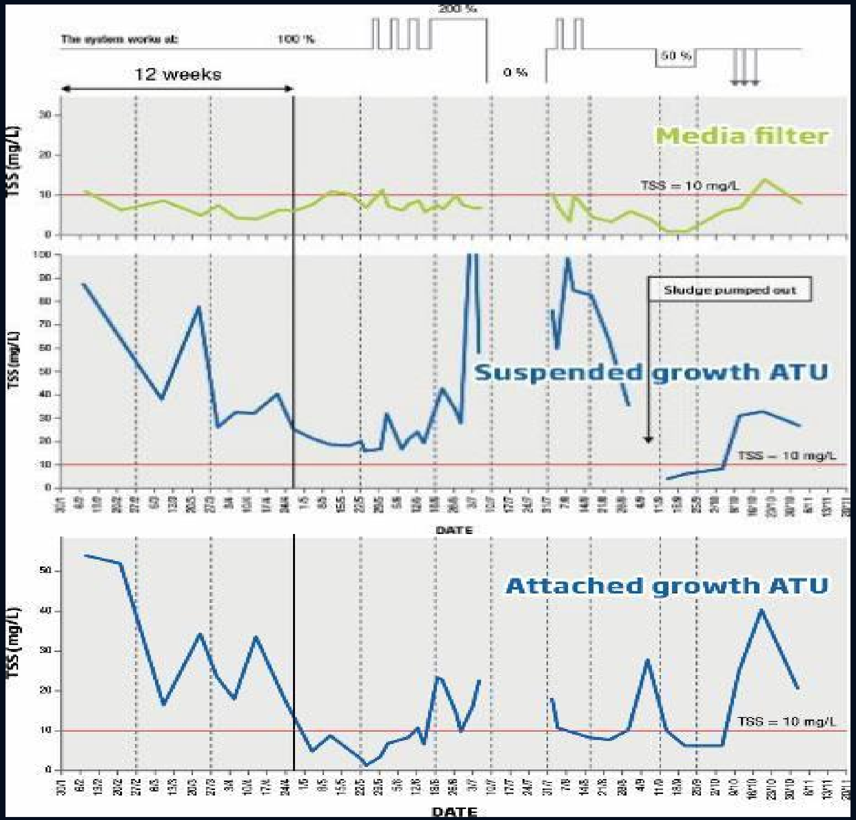
Existing Studies

EXISTING STUDIES

PLATFORM

Study of the performance of eight small sanitation facilities sized to treat a load of 300g BOD_5/d and tested together according to Veolia's protocol for demanding conditions.

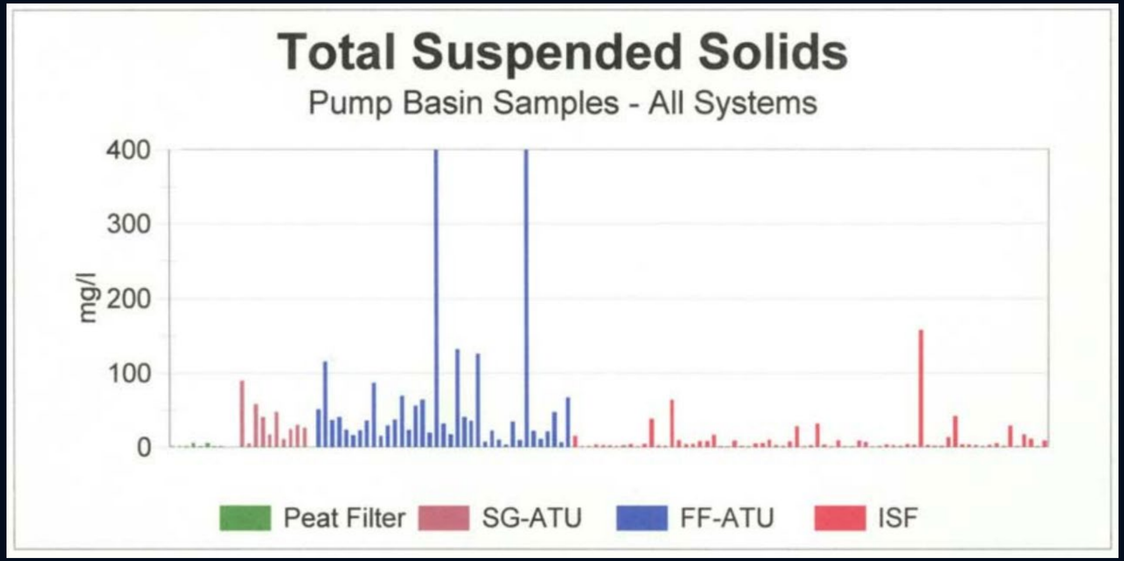
Report EN-CAPE 09.095 C - V1. CSTB & Veolia, 2009.



IN-SITU CONDITIONS

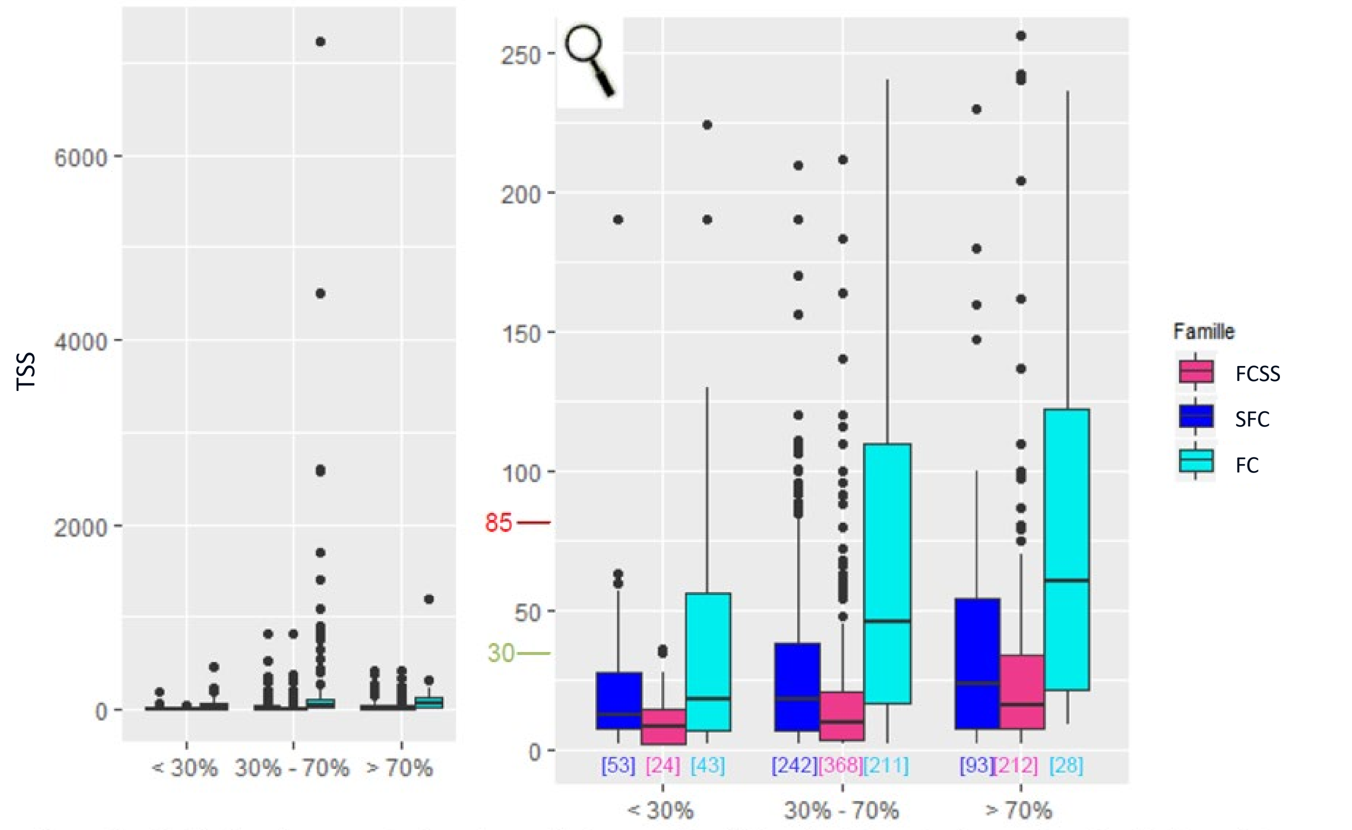
Reduction of Non-Point Source Pollution from On-Site Sewage Systems Under Real conditions in Clermont County Ohio.

Ohio EPA 319 Project #98(h) E-10; Final Technical Report; April 1998 to March 2001.



COMPARATIVE STUDIES: IN-SITU CONDITIONS

Onsite systems: in-situ monitoring of installations from 2011 to 2016. INRAe, 2017.



Concentrations distribution (mg/L) for TSS fonction of load – Right graph = Zoom in

FCSS: Fixed cultures on small support (n = 604)
(Sand filters, compact filters, etc.)

SFC: Submerged fixed cultures (n = 388)
(Package plants with attached growth)

FC: Free cultures (n = 282)
(Package plants with suspended growth)

COMPARATIVE STUDIES

- Comparative Study of Small Wastewater Treatment Technologies Under Special Operation Conditions COMPAS, Kompetenzzentrum Wasser Berlin, for Veolia, 2009.
- Household Sewage Treatment System Failure in Ohio – A Report on Local Health Department Survey Responses for the 2012 Clean Watersheds Needs Survey; ODH Bureau of Environmental Health; January 2013.
- Florida Department of Health Assessment of Water Quality Protection by Advanced Onsite Sewage Treatment and Disposal Systems; Performance, Management, Monitoring; Draft final report; August 2013.
- Assessment of the Performance and Management of Advanced Onsite Systems in Florida; Ursin, E., Roeder, E. 2013.
- Evaluation of Extended Aeration Activated Sludge Package Plants; Guo, P., Thirumurthi D., Jank, E.; Jurnal WPCF, Vol. 53, Number 1, 1981.

STUDIES - GENERAL OBSERVATIONS

Sporadic releases of sludge into the environment were observed for attached-growth and suspended-growth aerated treatment systems.

Premature clogging of infiltration zones was associated with these treatment technologies.

AERATED TREATMENT SYSTEM
Technology based mainly on mechanical aeration
Less robust to intermittent operating conditions or variable hydraulic and mass loads ▪ slow start-up (low occupancy or intermittent use) ▪ sensitive to overloading and load variations (modern lifestyle) ▪ → biomass stress → impacts solid-liquid separation
Requires some degree of operation and adjustment for best results ▪ performance conditional on proper functioning of electromechanical components (blower, air diffuser, pump, etc.)
No physical barrier to prevent release of solids

Recent Observations

From Third Party Testing Platforms

TEST ON POST FILTRATION SYSTEMS

Post filtration that provide a Physical barrier

- Tested on platforms (PIA – Germany; CSTB – France; BNQ – Canada)
- First application in Ireland to replace sand filter required before infiltration in sensitive area
  - ATU + sand filter + infiltration zone → ATU + coco filter + infiltration zone
- Second application developed for Scandinavian market
  - infiltration of treated water preferred due to sensitivity of receiving environment (many lakes, resorts)
  - filter installed between treatment system outlet and infiltration zone
  - effluent quality improved, but no treatment role
  - goal is protection of infiltration zone only

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THREE TESTING PLATFORMS:

- Germany - PIA (2016) – Aachen
- France – CSTB - Nantes
- Québec – BNQ – Lac St-Charles

PLATFORM TESTING #1

Filter – Downstream of a 2.7-day HRT SBR system treating 1,200 L/d for five months:

- Daily hydraulic loading rate on the filter : 400 L/m².d (10 gpd/sq.ft)
- SBR effluent continually discharged onto the filter
- 65 cm of coco (26 inches)

PIA (2016) – Aachen, Germany

	TSS (mg/L)		**BOD_5 (mg/L)**		**NH_4 (mg N/L)**	
	SBR effluent	Filter effluent	SBR effluent	Filter effluent	SBR effluent	Filter effluent
Arithmetic average	61	10	33	5	17	8
80^{th} percentile	50	12	19	5	26	10
Standard deviation	105	7	81	2	9	6
MIN	9	5	4	3	0	1
MAX	434	30	324	9	28	28
n	15	12	15	13	25	23

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PLATFORM TESTING #1

Filter – Downstream of the SBR system treating 1,200 L/d for five months:

PIA (2016) – Aachen, Germany

At end of test

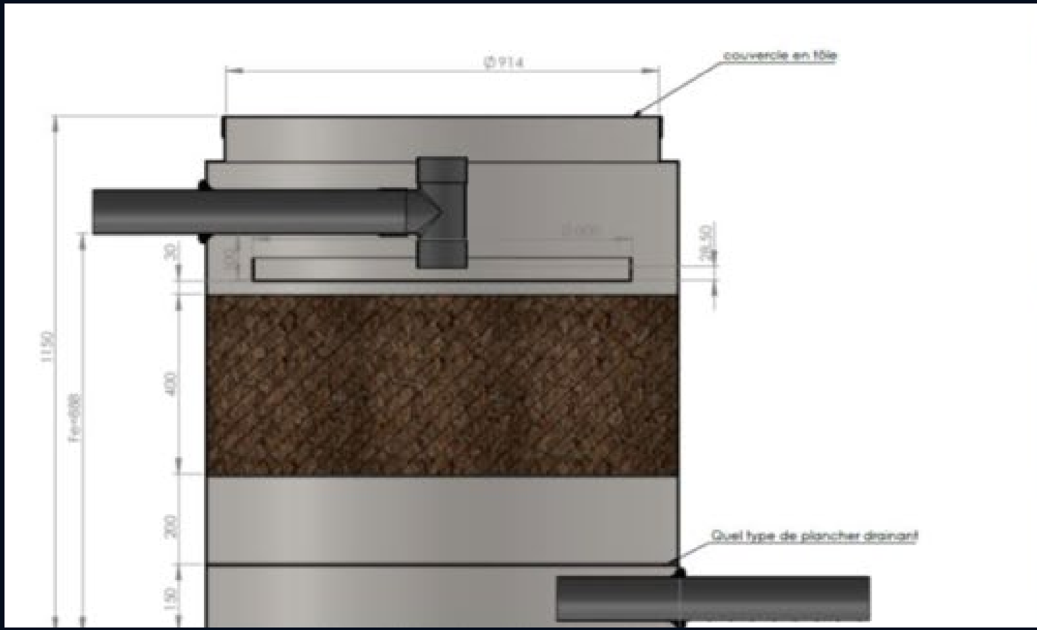
Following major sludge release (control malfunction)

PLATFORM TESTING #2 – FILTER 1

Filter 1 – Downstream of a 2.7-day HRT SBR system treating 750 L/d for four months

- hydraulic loading rate on the filter: 960 L/m².d (24 gpd/sq.ft)
- Fed by ~ 40-L (10 gal) batches every 10 minutes during SBR discharge
- 40 cm of coco (16 inches)

Centre Scientifique et Technique du Bâtiment (CSTB) (2017) – Nantes, France

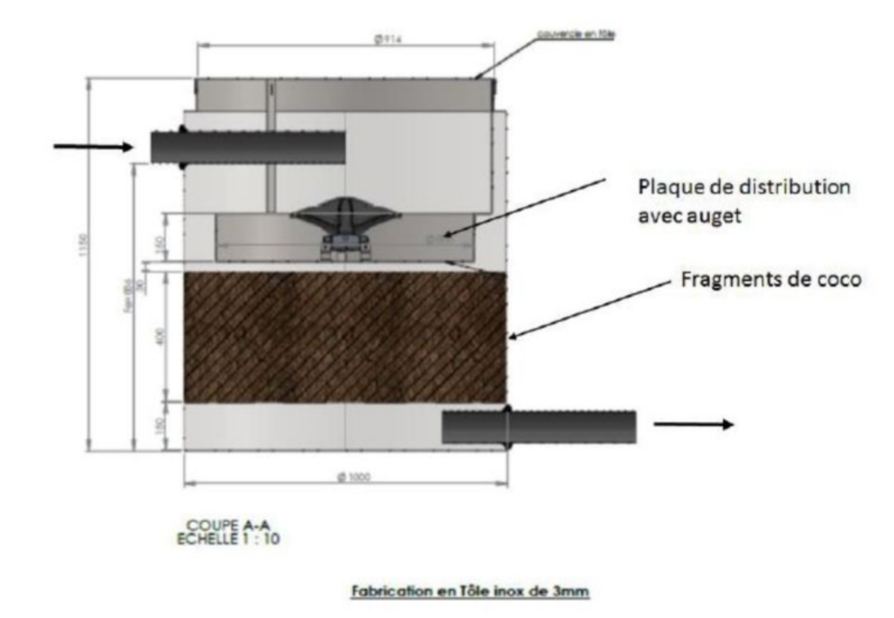


PLATFORM TESTING #2 – FILTER 2

Filter 2 – Fed with typical effluent of secondary treatment unit for seven months:

- hydraulic loading rate: 960 L/m².d (24 gpd/sq.ft)
- 40 cm of coco (16 inches)
- certification according to standard EN 12566-7 (five months + two months)

Centre Scientifique et Technique du Bâtiment (CSTB) (2018) – Nantes, France



PLATFORM TESTING #2

Centre Scientifique et Technique du Bâtiment (CSTB) – Nantes, France

Filter 1 –
Downstream of SBR system
(four months)

	TSS (mg/L)		BOD_5 (mg/L)		NH_4 (mg N/L)	
	SBR effluent	Filter effluent	SBR effluent	Filter effluent	SBR effluent	Filter effluent
Arithmetic average	113	3	14	2	27	14
80^{th} percentile	99	5	12	3	55	34
Standard deviation	257	2	27	1	36	16
MIN	2	2	2	2	1	1
MAX	990	7	110	5	120	40
n	19	20	19	20	19	20

Filter 2 –
Fed with typical effluent of secondary treatment unit (seven months)

	TSS (mg/L)		BOD_5 (mg/L)		NH_4 (mg N/L)	
	Secondary Treatment effluent*	Filter effluent	Secondary Treatment effluent	Filter effluent	Secondary Treatment effluent	Filter effluent
Arithmetic average	43	8	13	5	19	10
80^{th} percentile	54	11	17	8	30	15
Standard deviation	18	3	7	4	15	10
MIN	16	3	6	1	0	0
MAX	99	19	33	13	53	32
n	32	32	32	32	34	34

* Reconstituted typical secondary effluent

PLATFORM TESTING #2

Centre Scientifique et Technique du Bâtiment (CSTB) – Nantes, France

Impact of sludge release from SBR
(simulation of sludge removal not carried out in time)

PLATFORM TESTING #3

Filter – Downstream of 2-days HRT SBR system treating 1,260 L/d for six months

- CAN/BNQ 3680-600
- hydraulic loading capacity: 933 L/m².d (23 gpd/sq.ft)
- Fed by ~ 75-L (20 gal) batches every 10 minutes during SBR discharge
- 60 cm of coco (24 inches)

Bureau de Normalisation du Québec (BNQ) (2020) – Québec, Canada

PLATFORM TESTING #3

Bureau de Normalisation du Québec (BNQ) (2020) – Québec, Canada

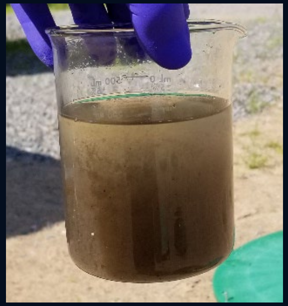
July to October 2020

Mixed liquor:

- insufficient ventilation
- poor flocculation

Daily release of concentrated sludge to the filter for two months, from August 8, 2020.

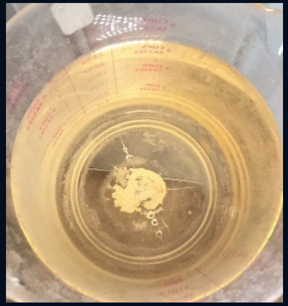
	TSS (mg/L)	BOD_5 (mg/L)	NH_4 (mg N/L)
	Filter effluent	Filter effluent	Filter effluent
Arithmetic average	7	6	16
80th percentile	9	7	22
Standard deviation	5	2	9
MIN	2	2	0
MAX	24	11	34
n	46	46	46



October to December 2020

Poor sludge flocculation
Daily release of sludge to the filter from Nov. 17, 2020.

	TSS (mg/L)	BOD_5 (mg/L)	NH_4 (mg N/L)
	Filter effluent	Filter effluent	Filter effluent
Arithmetic average	5	3	3
80th percentile	8	4	1
Standard deviation	3	2	6
MIN	2	2	0
MAX	18	10	21
n	56	56	56



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Applications

Need for Post Filtration

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DIFFERENT JURISDICTIONS:
POST-FILTRATION REQUIREMENTS

- Ireland:

ATUs always followed by a sand filter bed to protect the intration zone

- Germany:

Not mandatory

- Scandinavia/Sweden:

Not mandatory but highly implemented in sensitive area to provide additional protection to soil

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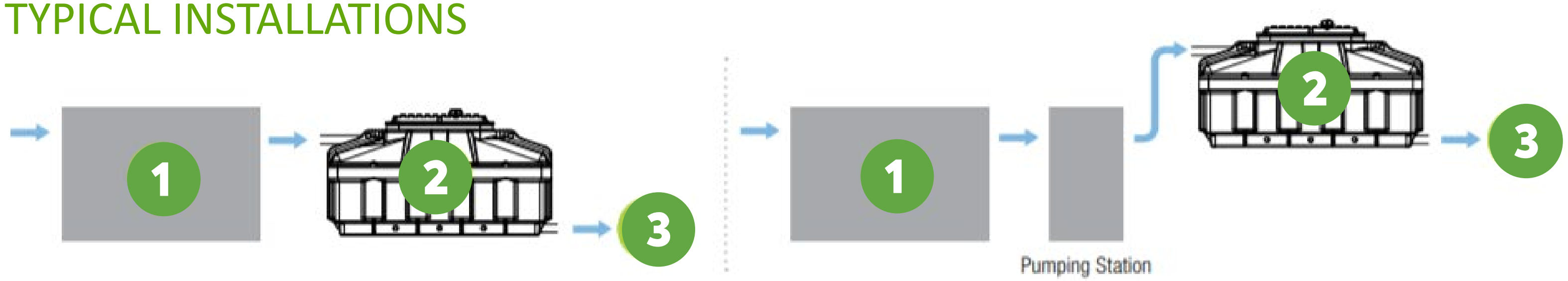
COMMERCIALIZATION - IRELAND

Post filtration

Start date:	2016
Nb systems:	> 100
Sizing criteria:	1000 L/m².d, (25 gpd/sq.ft)
	Infiltration directly under post-filtration or in separate infiltration zone

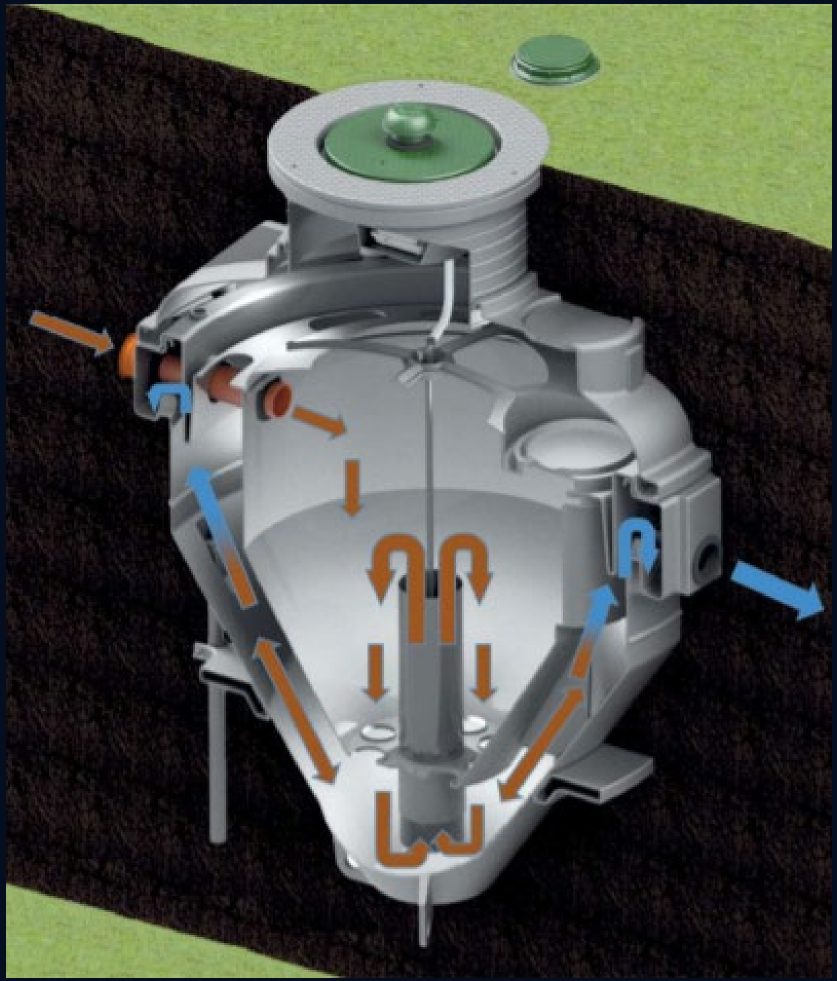
TYPICAL INSTALLATIONS



1. Aerated treatment system
2. Post filtration unit with 100% coco medium
3. Receiving environment

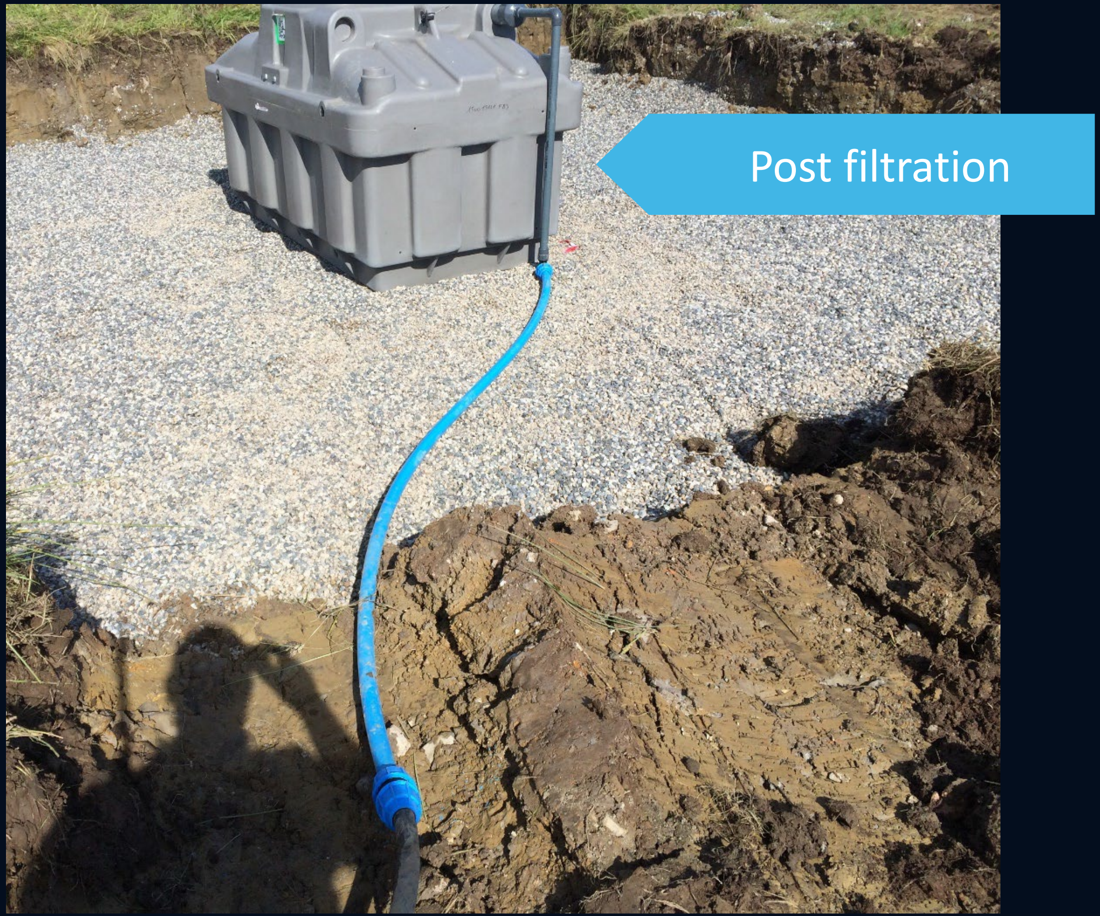
COMMERCIALIZATION - IRELAND

ASP (suspended growth system) sizing criteria ~225 L/PE → 1.5-day HRT



COMMERCIALIZATION - IRELAND

SBR system sizing criteria 400 L/PE → 2.7-day HRT



COMMERCIALIZATION – GERMANY, SCANDINAVIA

Start date: 2019

Units in service: 60

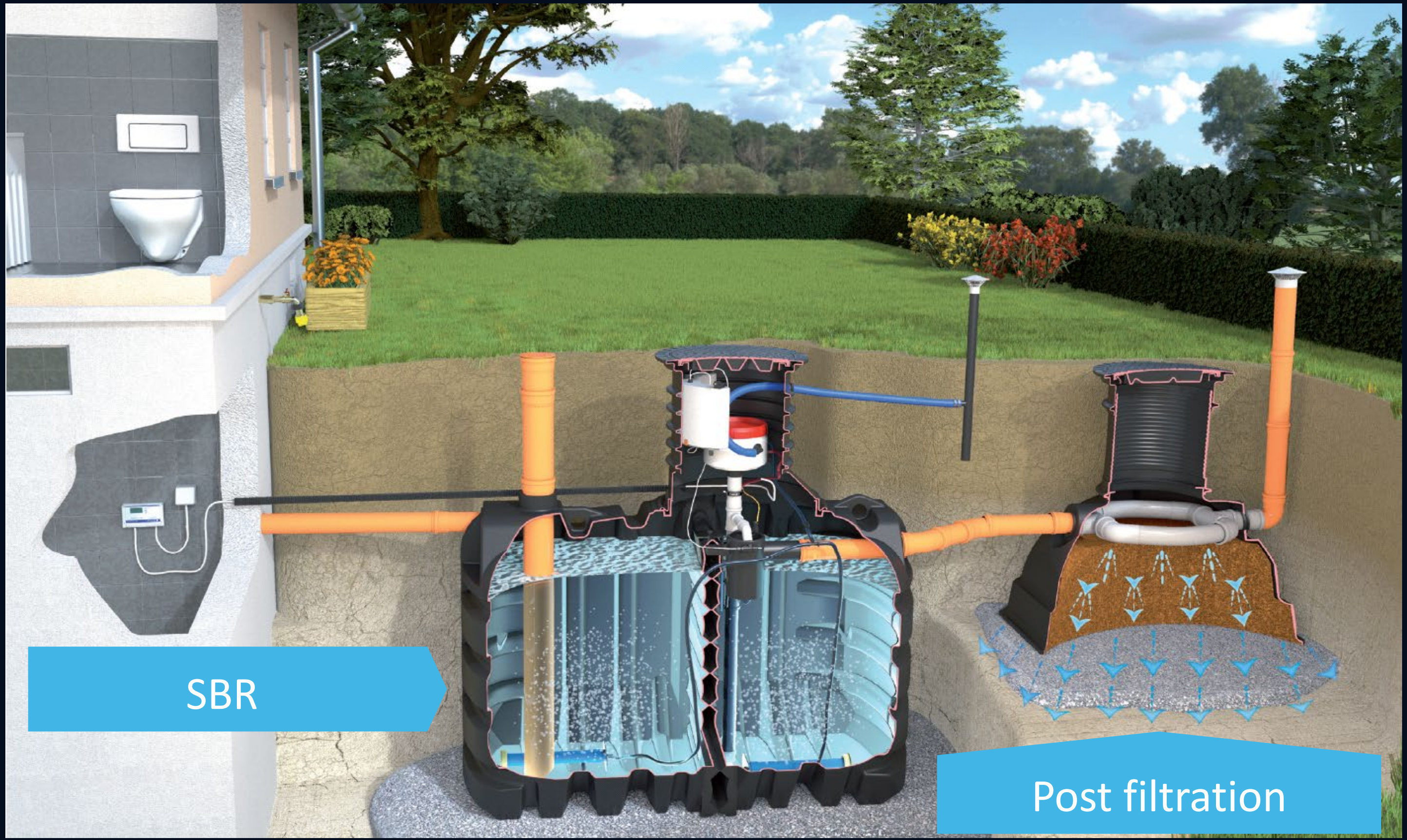
Sizing criteria: 1000 L/m².d

(25 gpd/sq.ft)

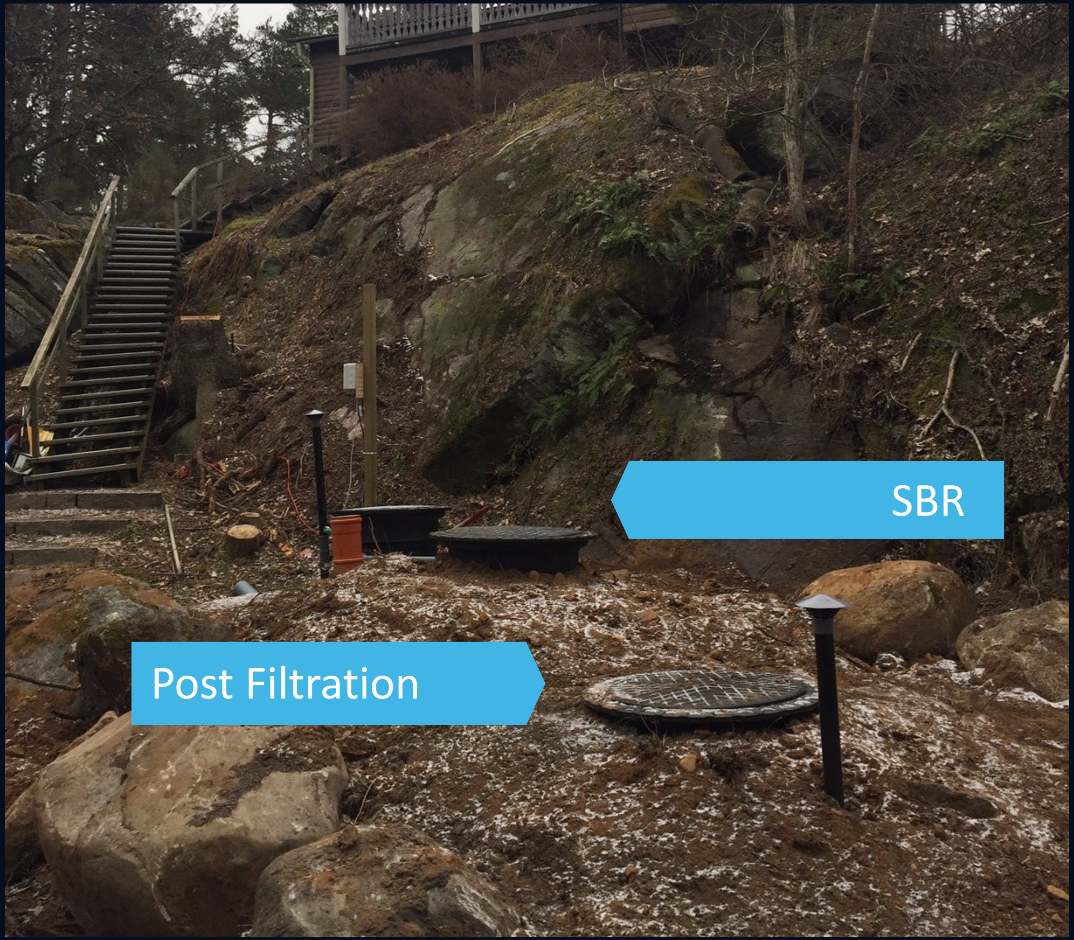
Infiltration directly under post filtration unit

SBR system sizing criteria

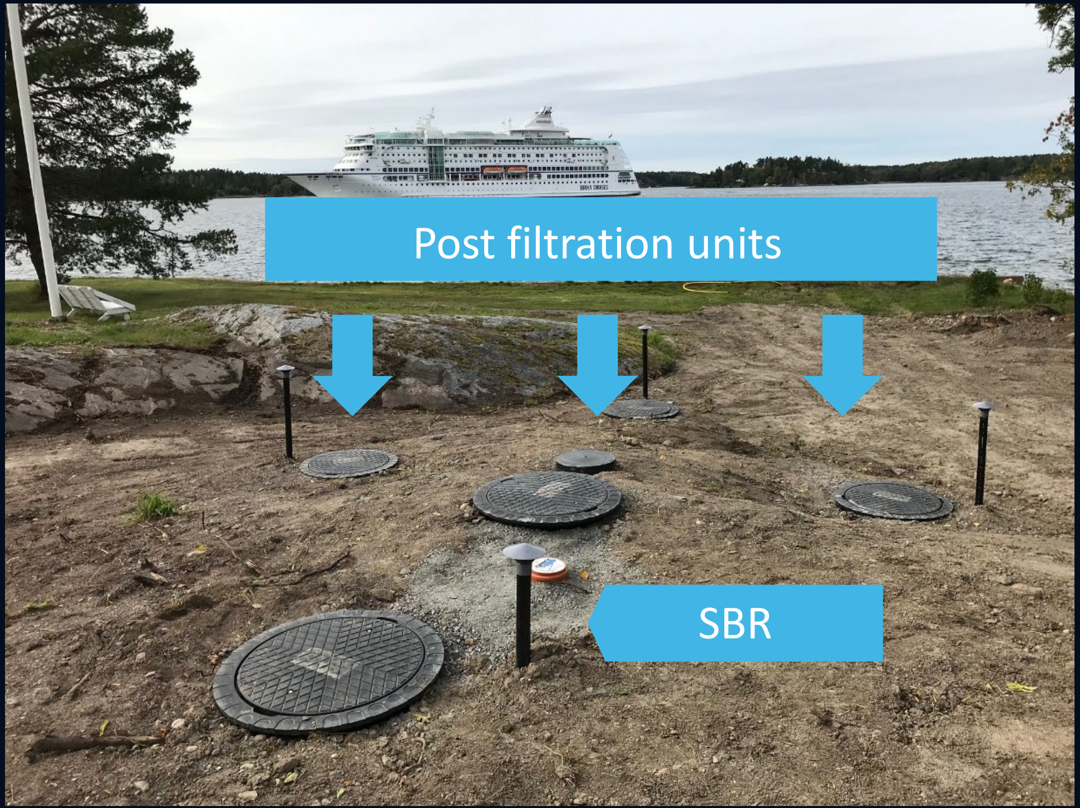
400 L/PE → 2.7-day HRT



COMMERCIALIZATION – GERMANY, SCANDINAVIA



COMMERCIALIZATION – GERMANY, SCANDINAVIA

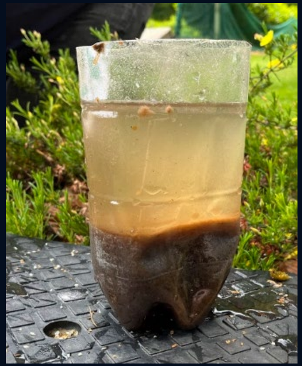


Recent Observations

From the Field

FIELD SURVEY – IRELAND
SBR/ATUS EFFLUENT




VISUAL APPRECIATION

6 /10 – Low effluent quality from secondary treatment unit

10 sites with SBR or ATUs + post-filtration



3/10 – Acceptable quality from secondary treatment unit

FIELD SURVEY – IRELAND
POST-FILTRATION SYSTEM



10/10

All post-filters with obvious signs of ATUs' low effluent quality.

A lot of sludge on surface or within filtering media

10 sites with SBR or ATU + post-filtration



FIELD SURVEY – SWEDEN: SBR/ATU EFFLUENT







Field investigation

- SBR + post-filtration – 5 sites
- SBR alone – 3 sites

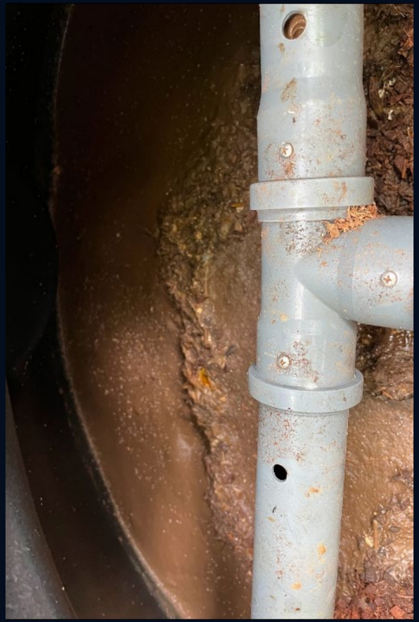
1/8 – No influent

3/8 – Large particles /sludgy effluent

4/8 – Cloudy SBR effluent

0/8 – Acceptable effluent

FIELD SURVEY – SCANDINAVIA: POST-FILTRATION



All < 2 years old post-filters showed significant sludge accumulation

Conclusions

Benefits of the Post Filtration

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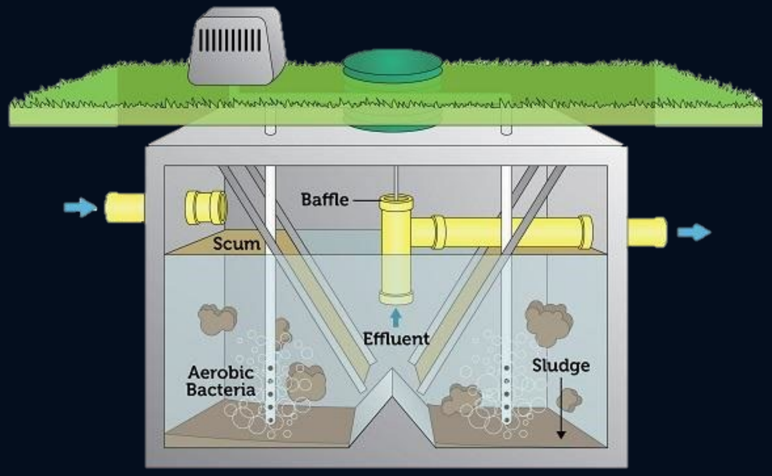
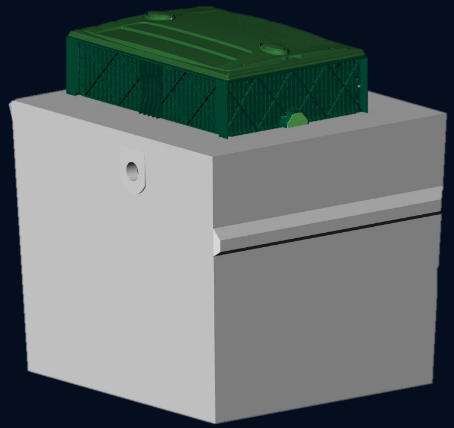
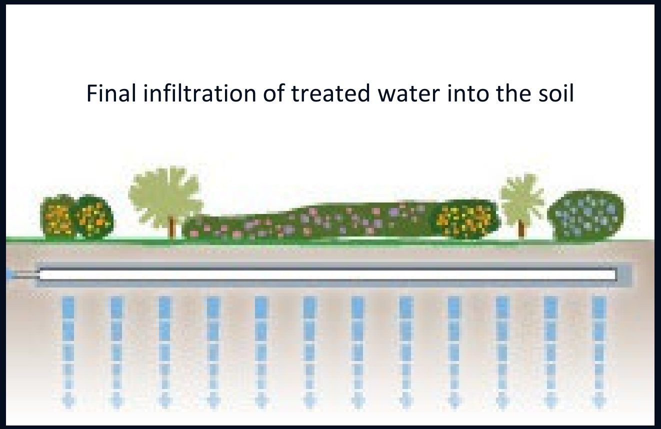
PROTECTION FILTER







Secondary treatment with attached or suspended growth

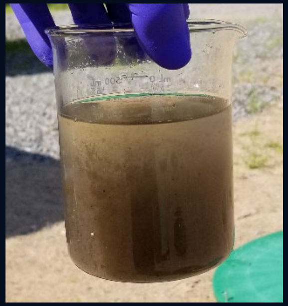
Physical barrier

Durability of infiltration zone

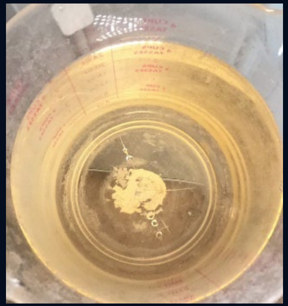
Performance of infiltration zone

Landscaping

ADDITIONAL BENEFIT!



ATU effluent



Post-filtration effluent

Performance Summary

Treatment contribution	TSS	BOD5	NH4
Reduction	> 85%	>80%	>50%

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Thanks for your time !

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