

Sveriges flaggskip RecoLab – Gjenbruk av svartvann og husholdningsavfall från Oceanhamnen Helsingborg

Interreg
North Sea



Co-funded by
the European Union

ANCHOR



Hamse Kjerstadius, Elin Ossiansson
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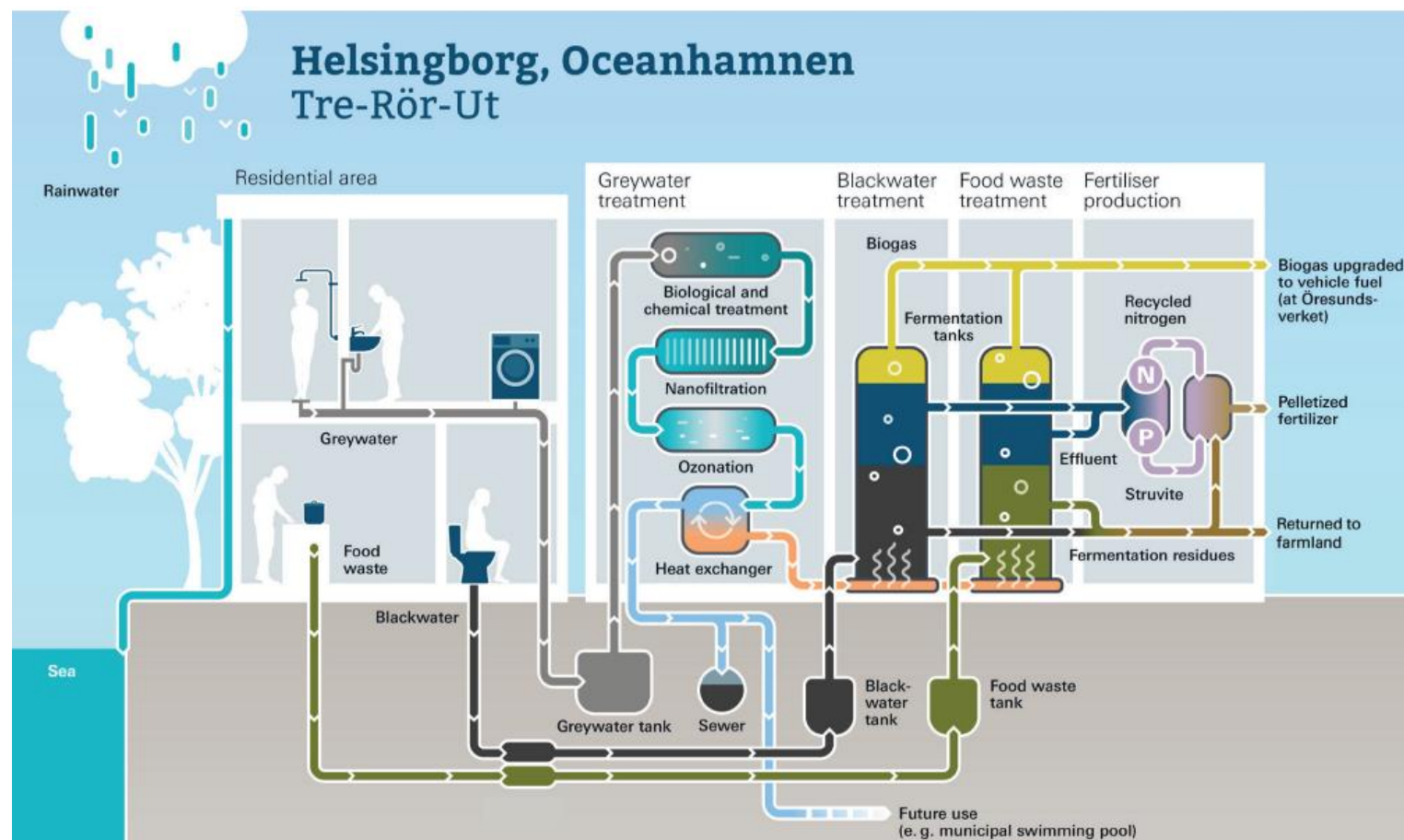


NORDVÄSTRA SKÅNES VATTEN OCH AVLOPP

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Källsorterat avloppssystem i Oceanhamnen, Helsingborg

- Källsortering i nytt område i Helsingborg
- Ett system för att producera mer energi och öka återvinning av näringsämnen och vatten





NORDVÄSTRA SKÅNES VATTEN OCH AVLOPP



Blackwater Vacuum Systems

What works now and what is left to solve?

Source Separated Sanitation Summit 2025

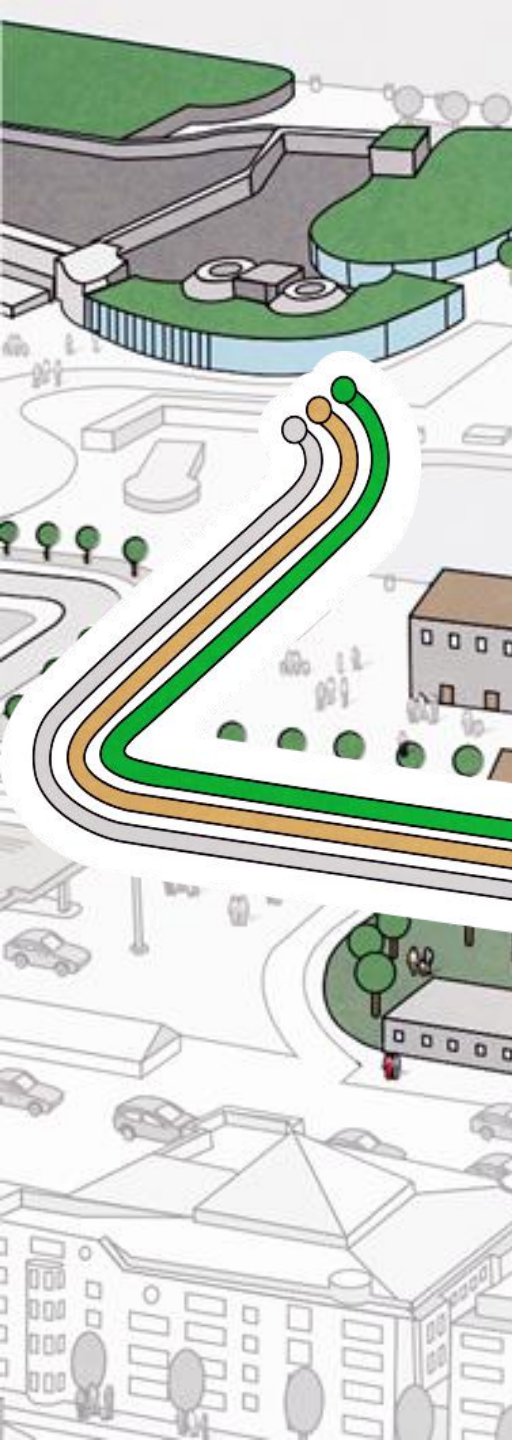
Hamse Kjerstadius (NSVA)

Paul Telkamp (TAUW)



Varför vakuum?

- Svartvattnet behöver vara koncentrerat för återvinning av resurser
 - *nu ca 50 x mer koncentrerat än vanligt avlopp!*
- Så koncentrerat avlopp flyttas inte med självfall utan tryck behövs
 - *vakuum mellan fastighet och pumpstation, därefter trycksatt avlopp.*
- Utmaning: vakuum kräver täta rör och ny kompetens för VVS-firmor.
- Inte en utmaning: vakuum kräver endast låg energiförbrukning (ca 10 kWh/capita/år)



European Experiences

ANCHOR

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5 larger demonstration areas (1000 – 2000 pe).

Oldest vacuum systems with plastic pipes are 50 years (sweden), others around 25 years (Germany and the Netherlands).

The long term maintenance is still unknown and thats why we develop maintenance plans within this project.



Old port and industrial site

Buiksloterham

waternet
waterschap amstel gooi en vecht
gemeente amsterdam



Treatment plants on a floating pontoon

SUPERLOCAL

WATERSCHAPSBEDRIJF
LIMBURG



Rainwater



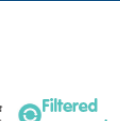
Drinking water



Grey water



Black water &
Food remnants



Filtered
grey water



Wash water

Grey water purification for laundries and car-wash

Helsingborg

Hamburg

Amsterdam

Kerkrade

Ghent

HWC Jenfelder Au



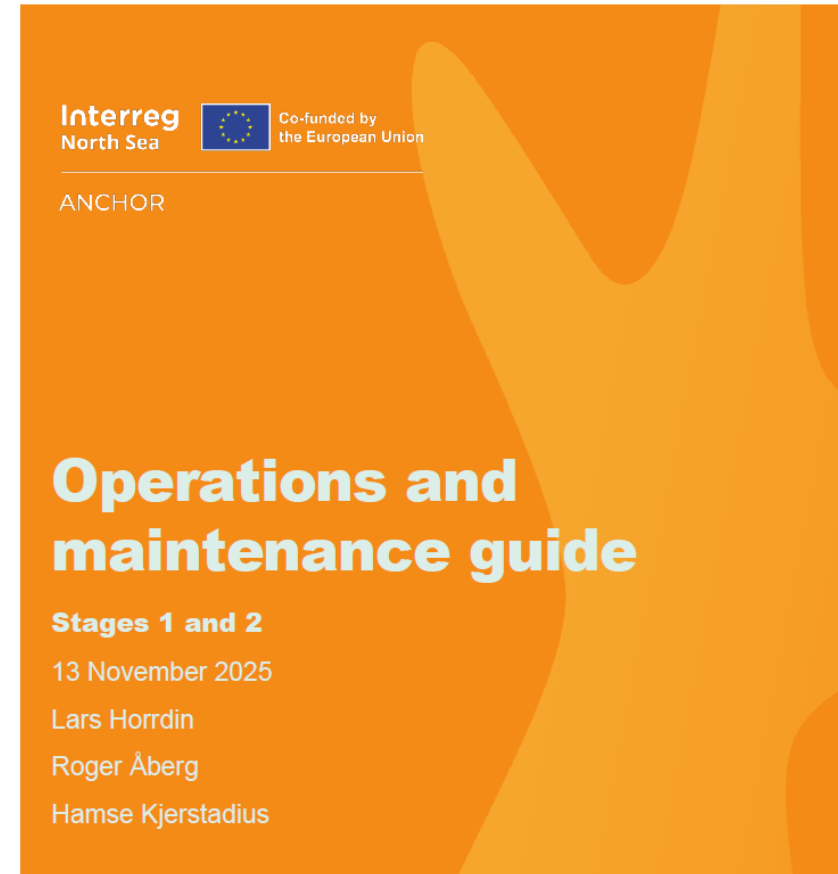
De Nieuwe Dokken



Examples off ANCHOR material on vacuum



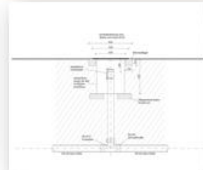
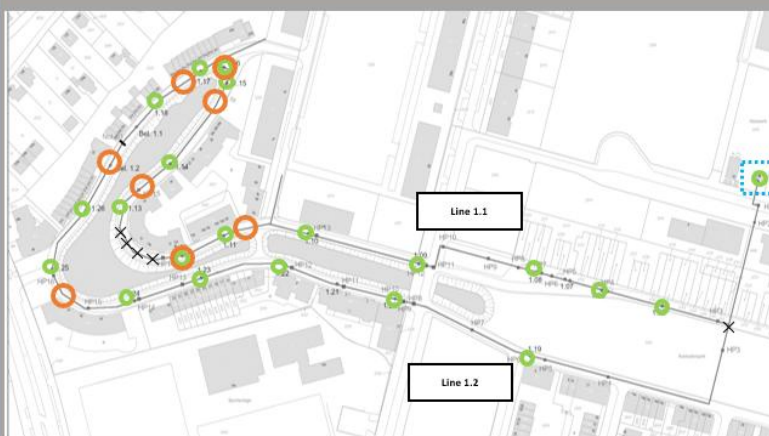
[Lunch talk: Improving vacuum systems ANCHOR | Interreg North Sea](#)



Workshops and comparison of best practice between countries

GERMANY - HAMBURG
JENFELDER AU - HAMBURG WASSER

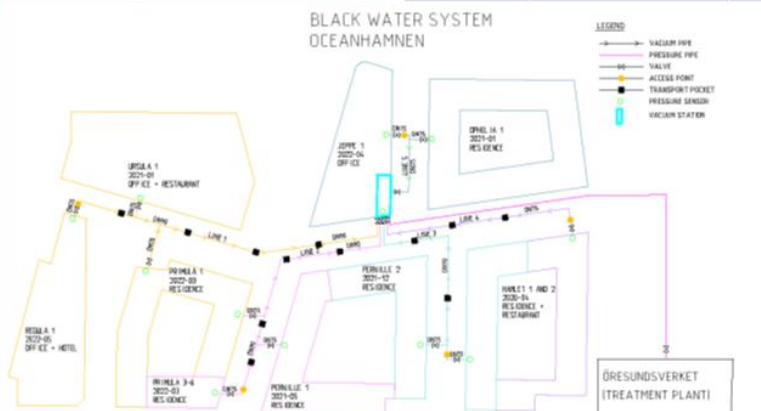
VACUUM SEWER NETWORK			VACUUM STATION		
HOUSING UNITS (and/or TOILETS)	835 <u>units</u> 1299 <u>vacuum toilettes</u>		VACUUM TANKS	2x 7 m ³ (Roediger)	
HOUSE CONNECTIONS	400		PRESSURE LEVEL	TANK 1: -0,65 <u>bar_{rel}</u> TANK 2: -0,45 <u>bar_{rel}</u>	
LENGTH PER LINE	3700 m (total) Line 1.1 + Line 1.2 (Tank 1) Line 2 + Line 3 (Tank 2)		BLACKWATER PUMPS	4x	
DIAMETER	90-125 mm		VACUUM COMPRESSORS	6 x 250 m ³ /h	
MATERIAL	High density polyethylen (HDPE)		EXHAUST AIR TREATMENT	4 x <u>activated carbon filter</u>	



Classificatie: Intern

SWEDEN - HELSINGBORG
OCEANHAMN - NSVA

VACUUM SEWER NETWORK		VACUUM STATION	
HOUSING UNITS (and/or TOILETS)		VACUUM TANKS	No vacuum tanks. Jets system works without vacuum buffer.
HOUSE CONNECTIONS	11	PRESSURE LEVEL	0,42 – 0,52 bar
LENGTH PER LINE	Line 1: 132 m, Ø 90 mm Line 2: 105 m, Ø 90 mm Line 3: 83 m, Ø 90 mm Line 4: 89 m, Ø 75 mm Line 5: 25 m, Ø 75 mm	BLACKWATER PUMPS	2 x Flygt
DIAMETER	Ø 75-90 mm	VACUUM COMPRESSORS	4 x Jets 190 MB
MATERIAL	High density polyethylen (HDPE)	EXHAUST AIR TREATMENT	Activated carbon filter



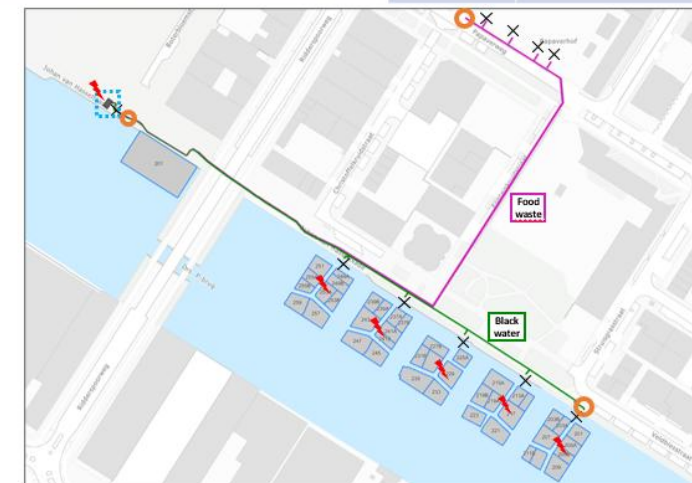
Pressure sensor with display and



Classificatie: Intern

NETHERLANDS - AMSTERDAM
SCHOONSHIP - WATERNET

VACUUM SEWER NETWORK		VACUUM STATION	
HOUSING UNITS (and/or TOILETS)	Blackwater: 42 houses, 84 toilets Food waste: not operational yet	VACUUM TANKS	1x 2 m ³
HOUSE CONNECTIONS	Blackwater: 5 Food water: 4	PRESSURE LEVEL	Between -0,6 and -0,7 bar
LENGTH PER LINE	Blackwater: 375 m Food waste: 505 m	BLACKWATER PUMPS	2
DIAMETER	ø 97 mm	VACUUM COMPRESSORS	2
MATERIAL	PE 100 SDR 17 PN 8	EXHAUST AIR TREATMENT	Activated carbon filter





What works with blackwater vacuum?

- Sewer transport & pumps
- Treatment and resource recovery
- Growing market of supplier solutions



Blackwater sewer transportation and treatment works

- Blackwater vacuum systems are **increasing in scale** (approx. 2 000 persons) and into municipal utilities.
- In the demo sites we are developing best practice for **operation of the sewer network and pumping stations**. But it runs already today (Helsingborg 15 000 flushes a day).
- The **treatment of blackwater is confirmed** to generate more biogas and concentrations suitable for nutrient recovery. This makes resource recovery plants a real possibility.
- It is vacuum systems in the buildings we really need to solve to achieve greater spread of these systems.





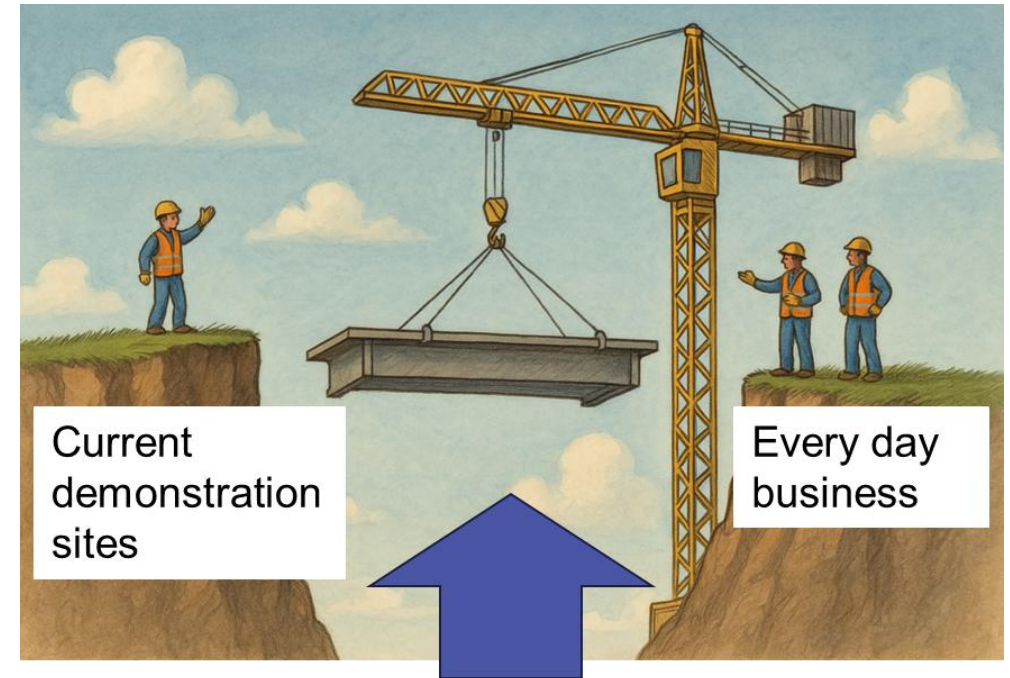
Left to solve with blackwater vacuum

- Scaling in pipes
- Unified design & guidelines
- Lack of market available
operation & maintenance for buildings



Final thoughts on vacuum

- Vacuum systems for blackwater have been promoted by universities since the late 90's in order to enhance resource recovery. The last 10 years has seen the first municipal demonstration sites of a few thousand people.
- The vacuum technology is not yet fully matured, more work on acoustics and certifications of plumbing companies needs to be developed. As well as the interface between private properties and the municipal sewer network.
- Vacuum systems gives a very nice and smooth blackwater which is beneficial to treat at the WWTP. It is a promising technology for the future.
- Further spread of the landbased vacuum systems will develop best practice among suppliers and installation companies.
- **News 2026: Formation of a blackwater vacuum network with suppliers and municipal organisations!**

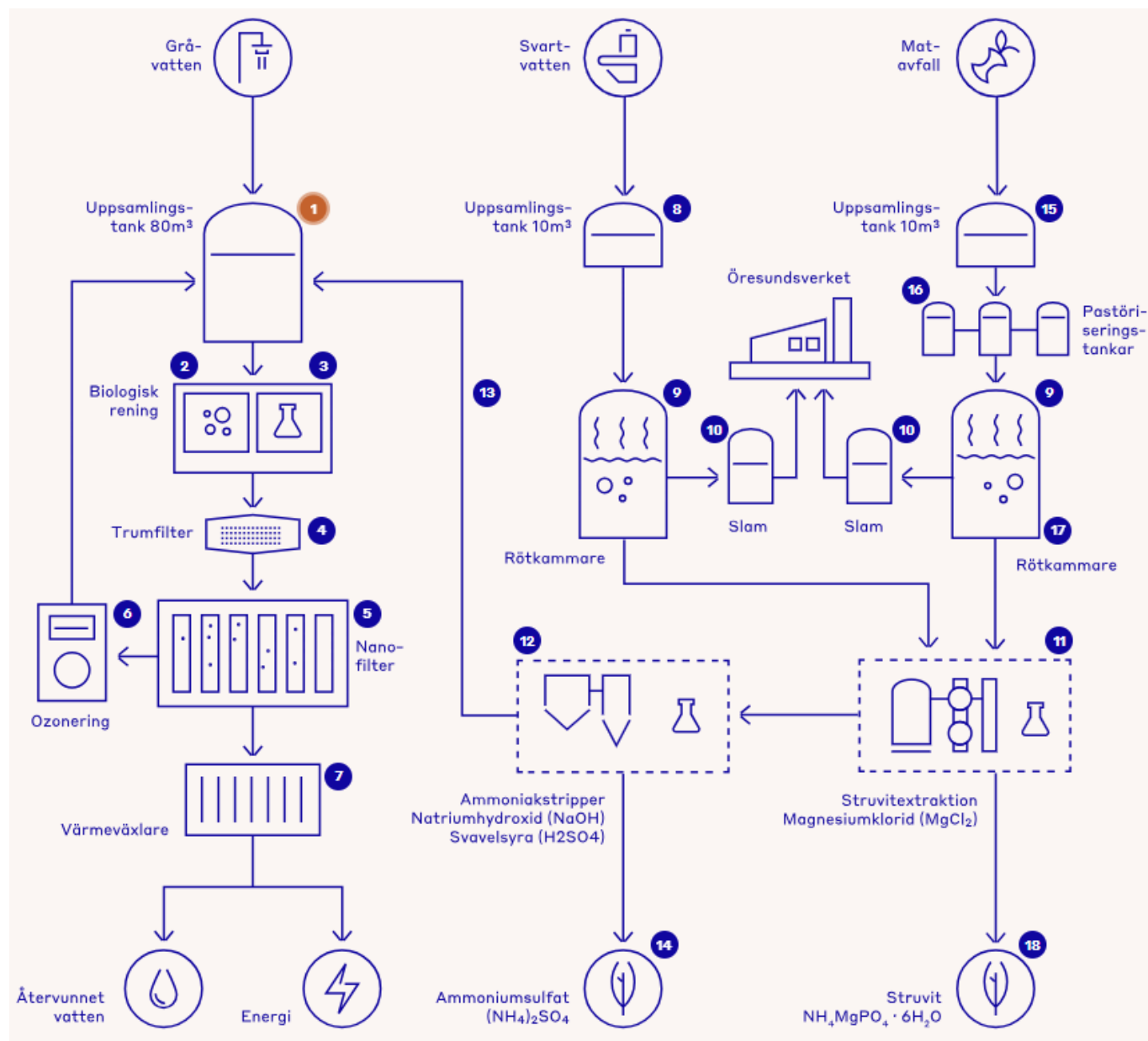


This gap has to be filled. The only way to fill it is by:

- 1) *More demonstration sites.*
- 2) *Increased knowledge spreading to developers, plumbing companies and O&M*

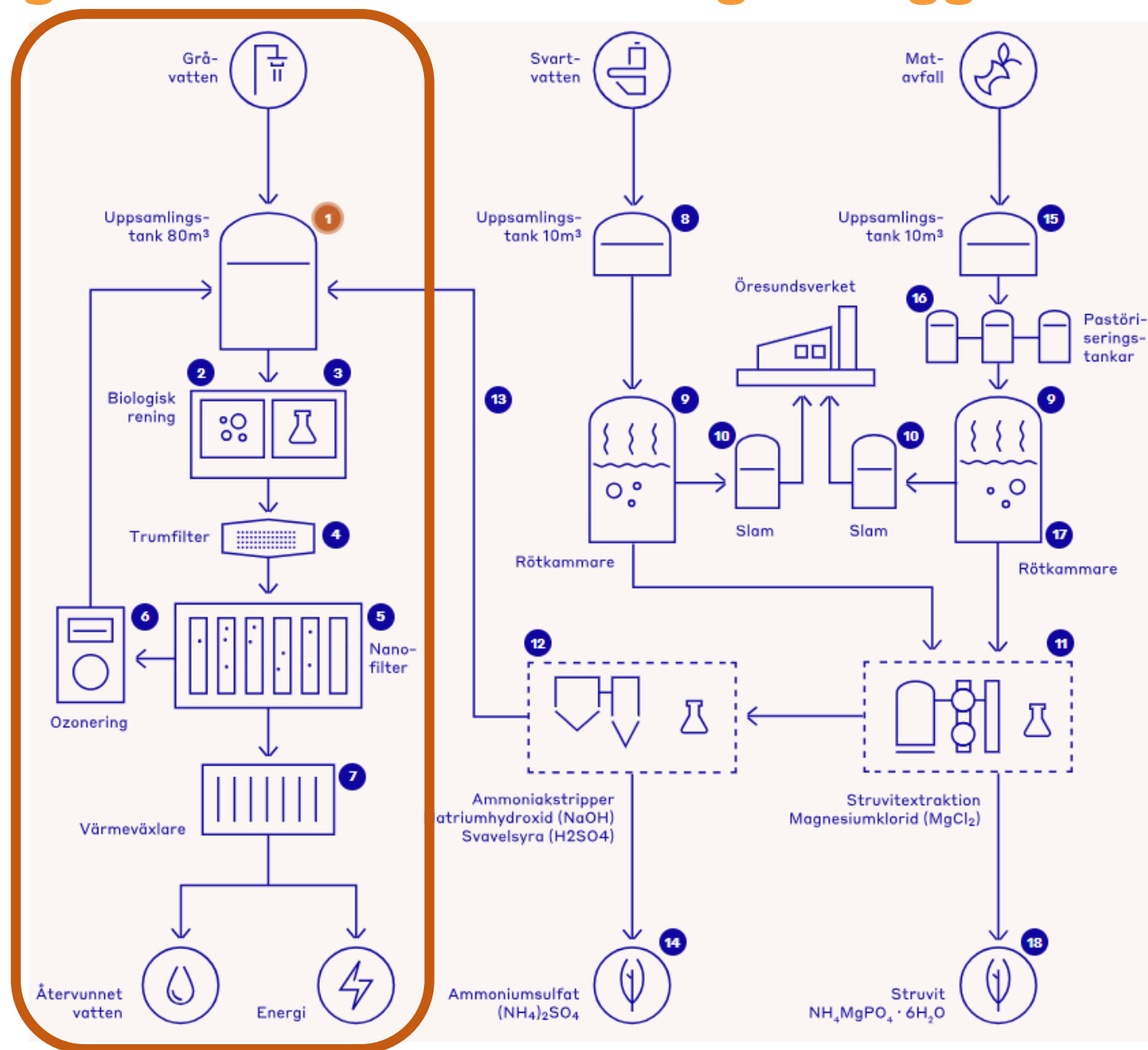
Utvecklingsanläggningen RecoLab: behandlingsanlegg

- Gråvatten
- Svartvatten
- Matavfall



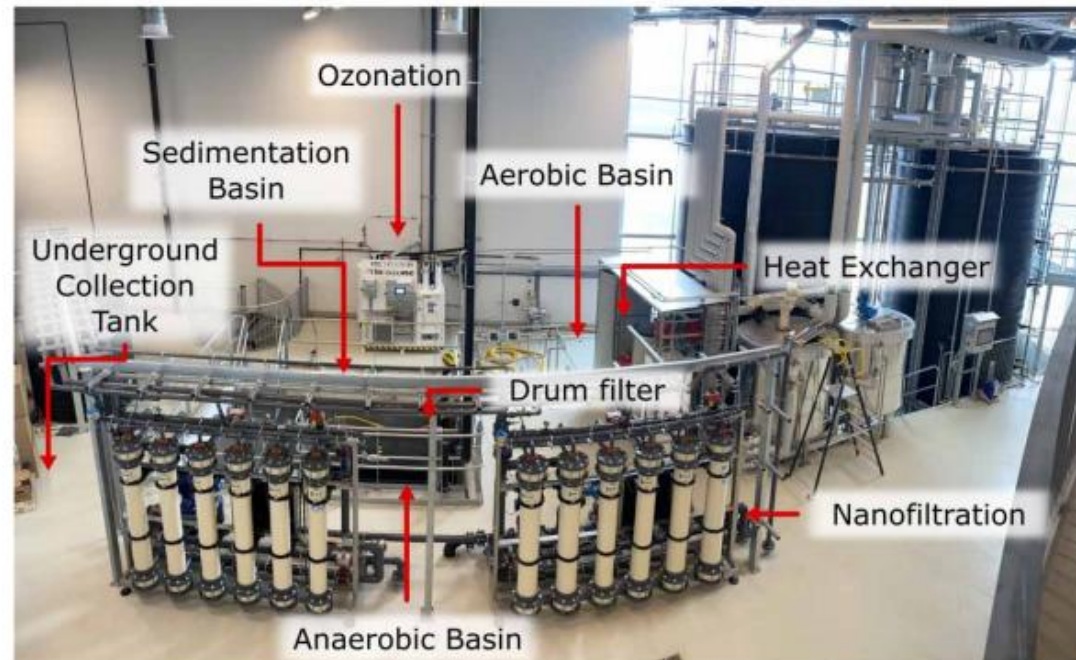
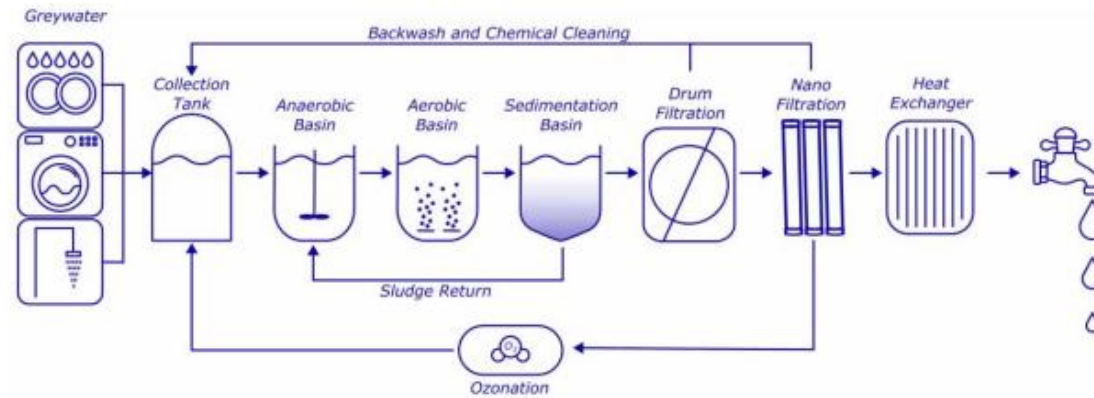
Utvecklingsanläggningen RecoLab: behandlingsanlegg

- Gråvatten



Gråvattenrening

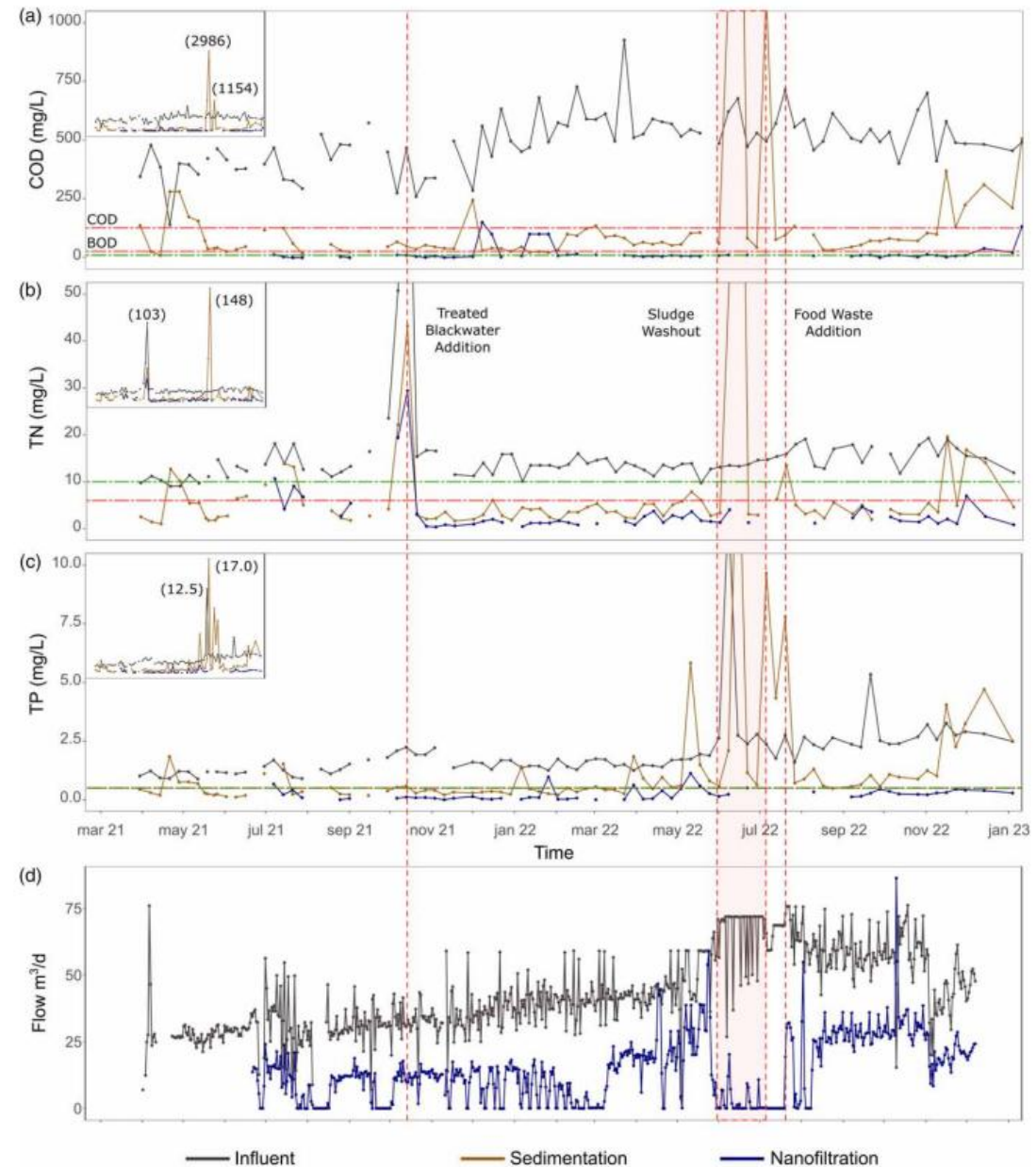
- Aktivslam, trumfilter och nanofilter
- Extra pilot med kolfilter och UV
- Gjenbruk av renat gråvatten möjligt



Hall, A. et al. (2024) Treatment of greywater with nanofiltration for nutrient removal – 2-year experience from Helsingborg
doi: 10.2166/wpt.2024.050

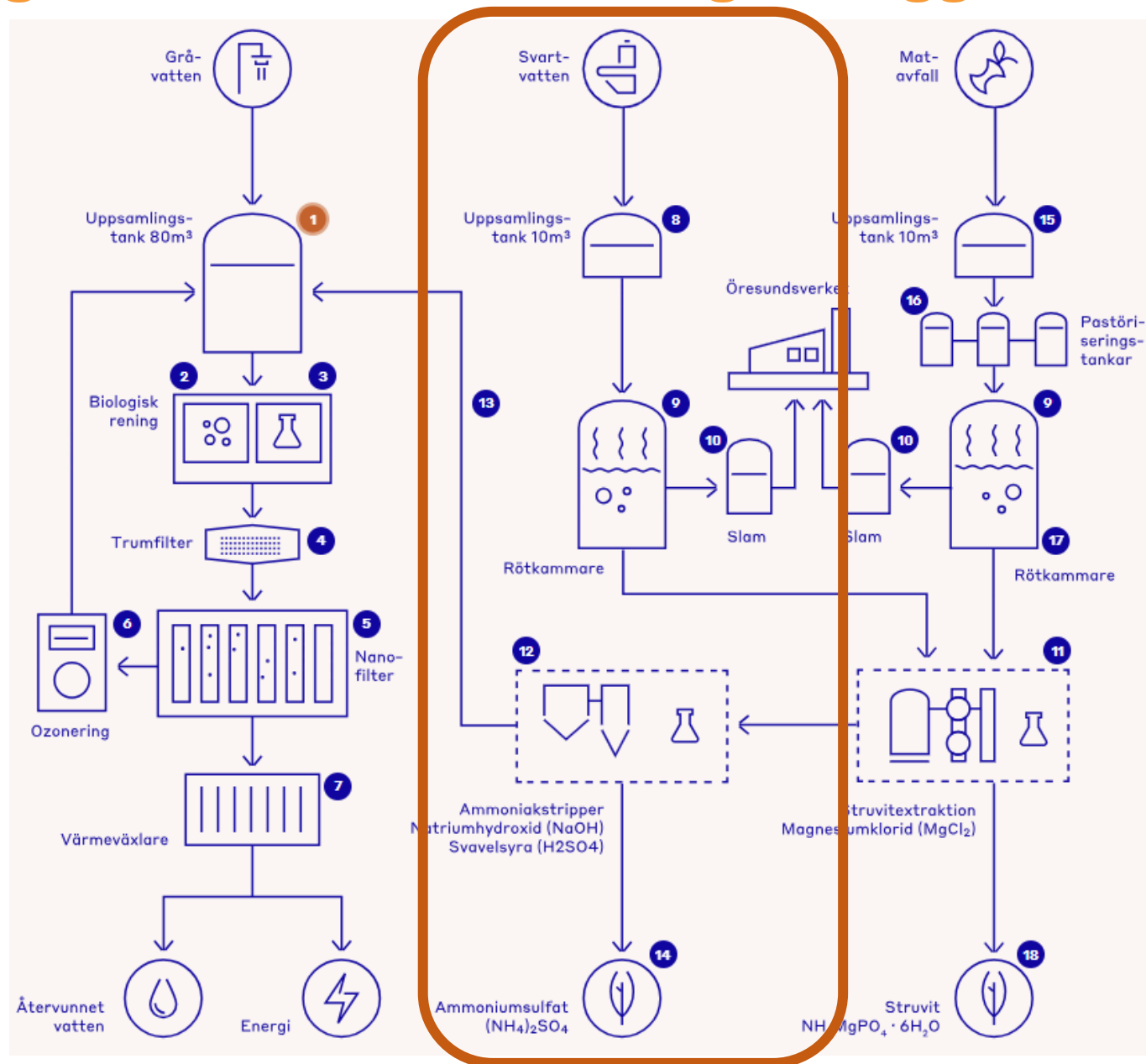
Gråvattenrening

- Ut från nanofilter:
- COD 9 + 14 mg/l
- TN 2,6+ 2,4 mg/l
- TP 0,21 + 0,21 mg/l



Utvecklingsanläggningen RecoLab: behandlingsanlegg

- Svartvatten



Svartvatten passar för biogasproduktion

Mera biogas med källsorterat system!

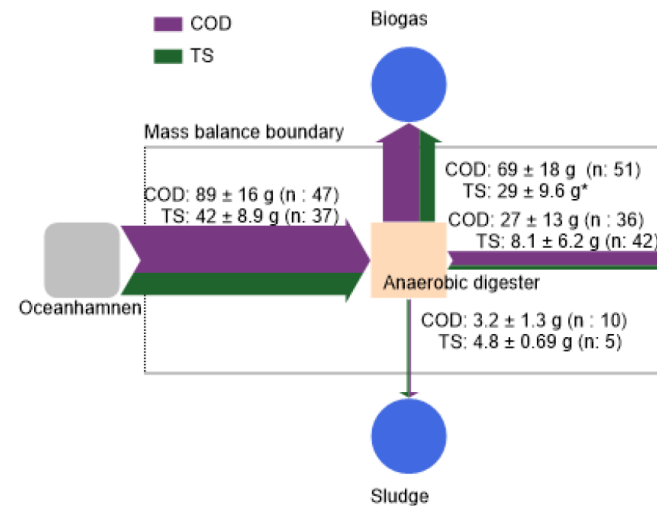
- COD i svartvatten tillräckligt hög för rötning
- Approx. 3m³ biogas per m³ svartvatten
- 22 NL CH₄/pe/d → 65% mer biogas per person*



* As compared to the biogas production from municipal wastewater: <https://doi.org/10.1016/j.jenvman.2017.03.094>

Svartvatten passar för biogasproduktion

- 80% TS och 70% COD reduktion
- Låg slamproduktion
- Optimering av driften och slamtäcket i UASB i ANCHOR



DEGREE PROJECT

L

The mass balance of compounds in
source-separated blackwater treatment
at RecoLab, Helsingborg

Lisa Gren

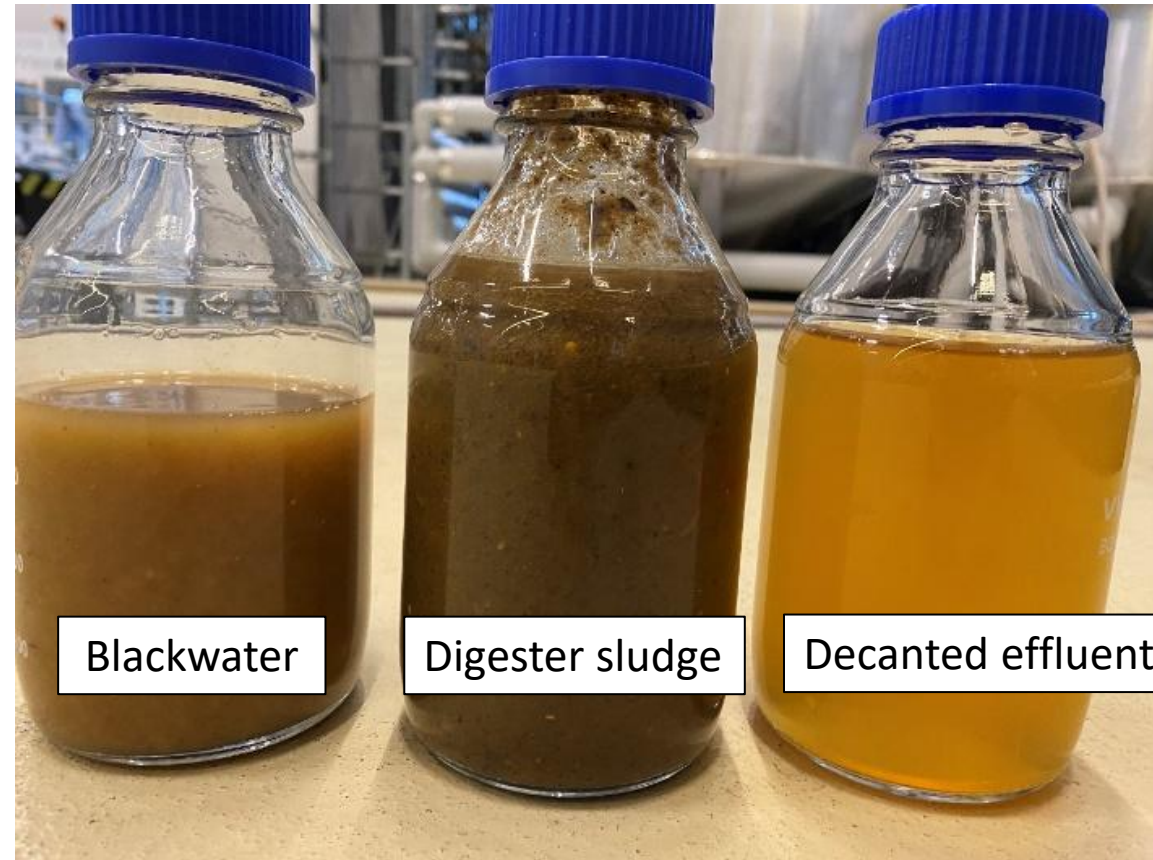
Natural Resources Engineering, master's
2024

Luleå University of Technology
Department of Civil, Environmental and Natural Resources Engineering



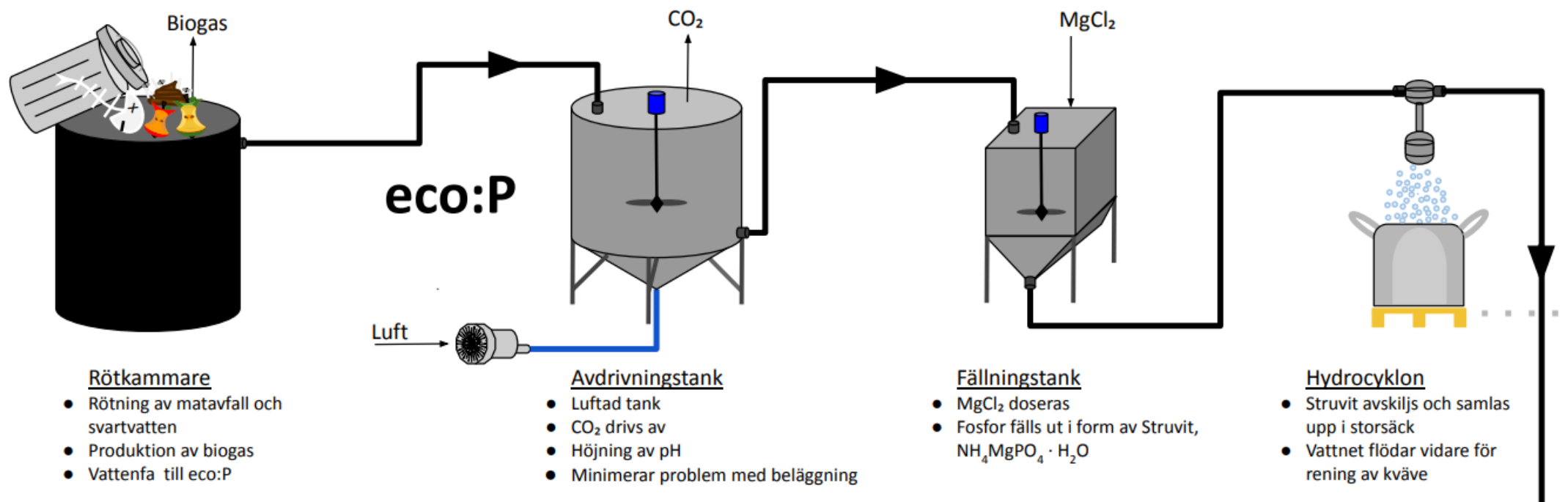
Svartvatten efter rötning

- 98% av kväve ($1\ 200\text{ mg NH}_4\text{-N/L}$)
- 85% av fosfor ($90\text{ mg PO}_4\text{-P/L}$)
- Goda förutsättningar för återvinning (gjenbruk) av N och P



Utvecklingsanläggningen RecoLab: P- gjenbruk

- Struvitfällning genom tillsats av MgCl_2
- Satsvis process som bildar mindre kristaller



Struvit: gjenbruk av P

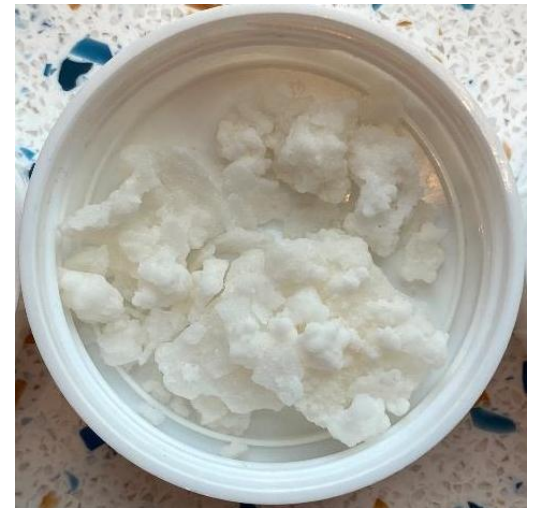
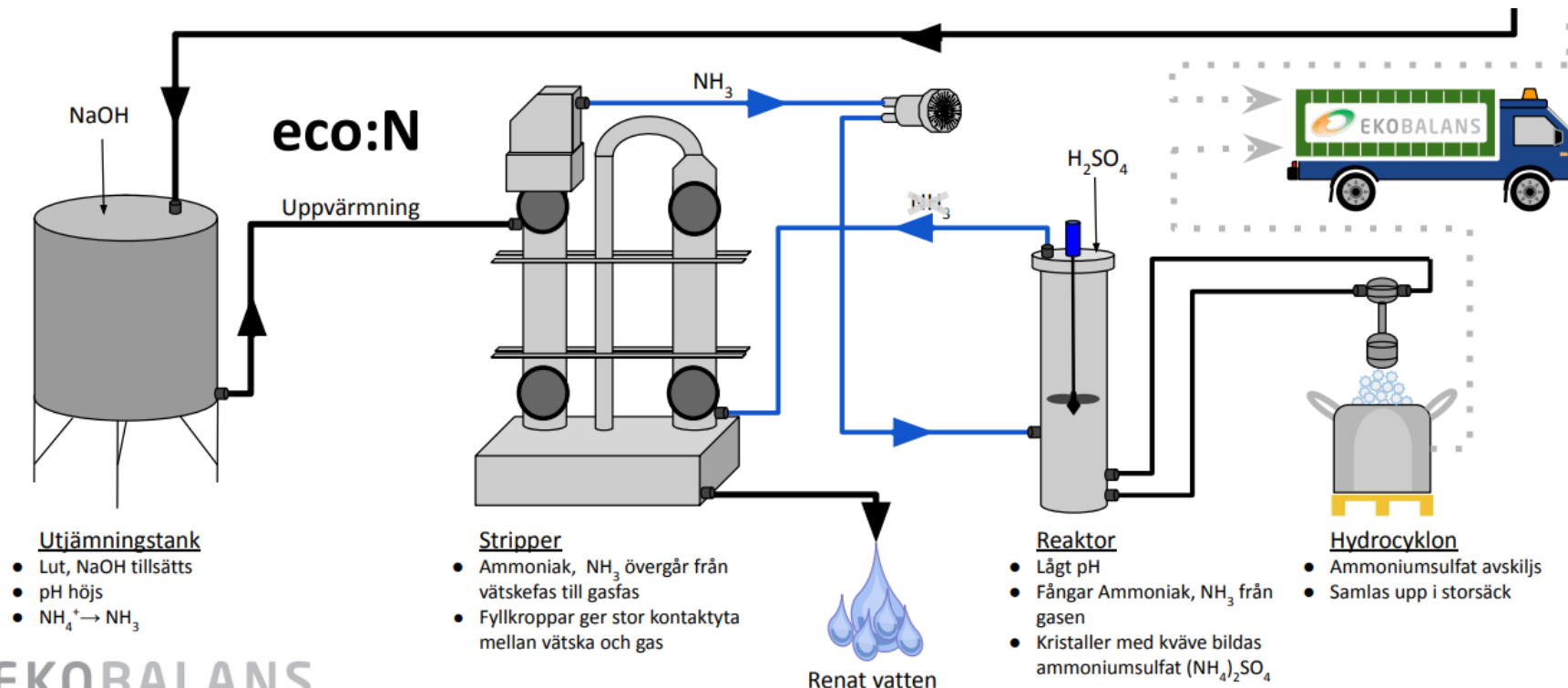
- Finns i Helsingborg, Ghent, och Nederländerna
- EU fertilizer (2019/1009). End of waste & ekologisk odling
- Ren produkt ($\text{Cd}/\text{P} < 1$)!

Object	mg Cd/kg P
RecoLab influent	8.1
RecoLab sludge	13
RecoLab struvite	0.68
SPCR178 certification	17
Revaq certification	22



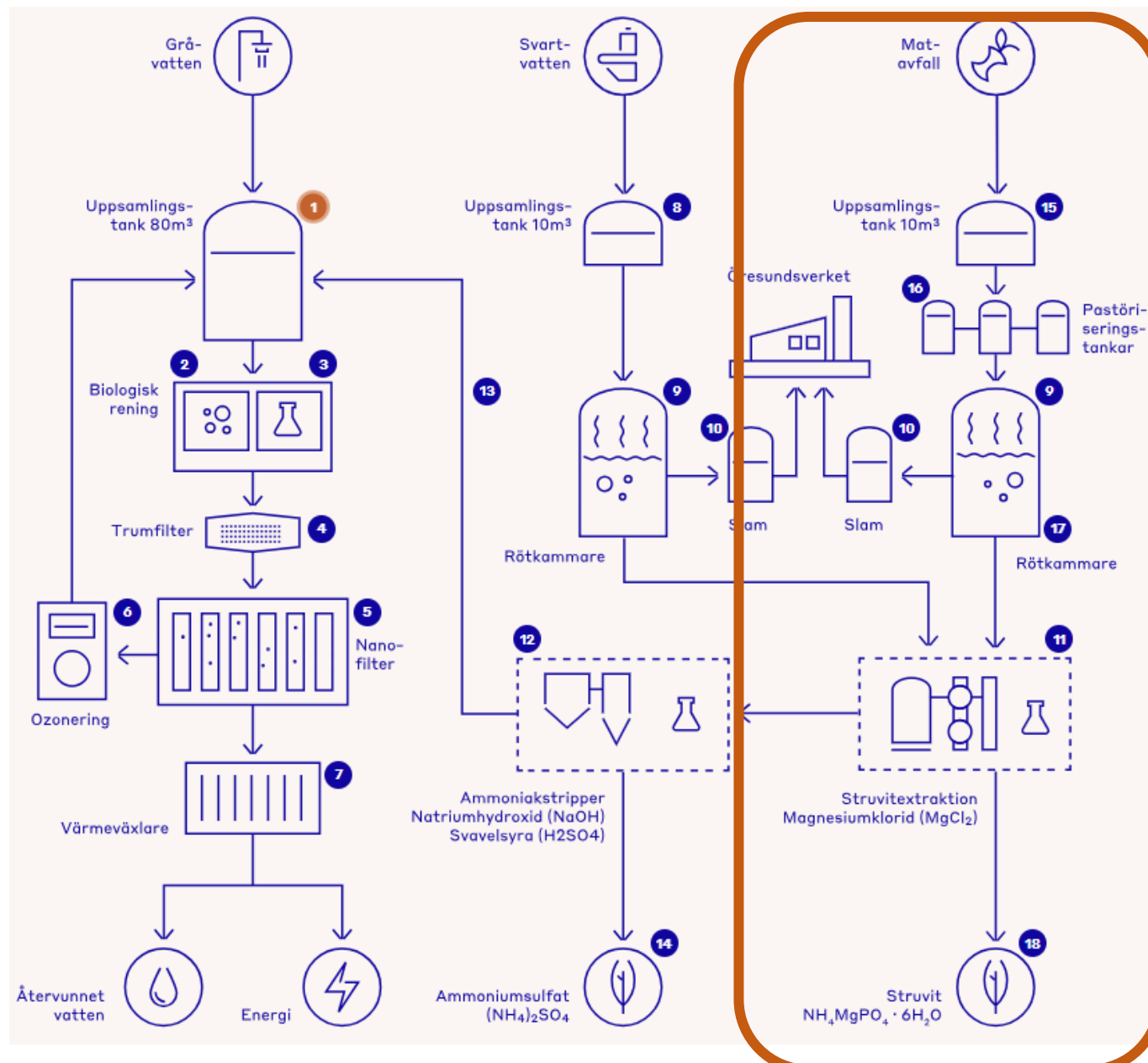
Utvecklingsanläggningen RecoLab: N- återvinning

- Stripper och reaktor med tillsats av svavelsyra
- Ammoniumsulfat i fast form



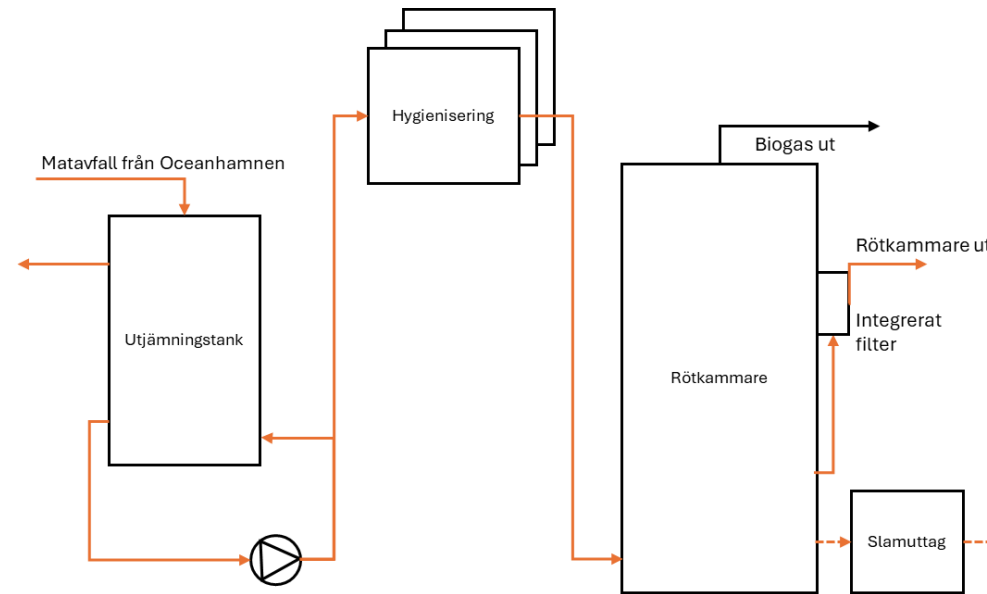
Utvecklingsanläggningen RecoLab: behandlingsanlegg

- Matavfall



Utvecklingsanläggningen RecoLab: matavfall

- Utspätt matavfall
- Ska byggas om för att få ett tjockare matavfall till rötning



Nuvarande utformning

Tack för oss!



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