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Swedish Agency for Marine and Water Management

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PILOT PLANT IN SVEDALA

Michael Cimbritz and Åsa Davidsson
Lund University

Background – R&D in Sweden

For four years, from 2014 to 2017, the Swedish Agency for Marine and Water Management was assigned by the government to promote advanced treatment of wastewater by supporting projects in order to develop treatment methods for municipal treatment plants.

[Treatment techniques for pharmaceuticals and micropollutants in wastewater - Publications - Swedish Agency for Marine and Water Management (havochvatten.se)]


Swedish Agency for Marine and Water Management

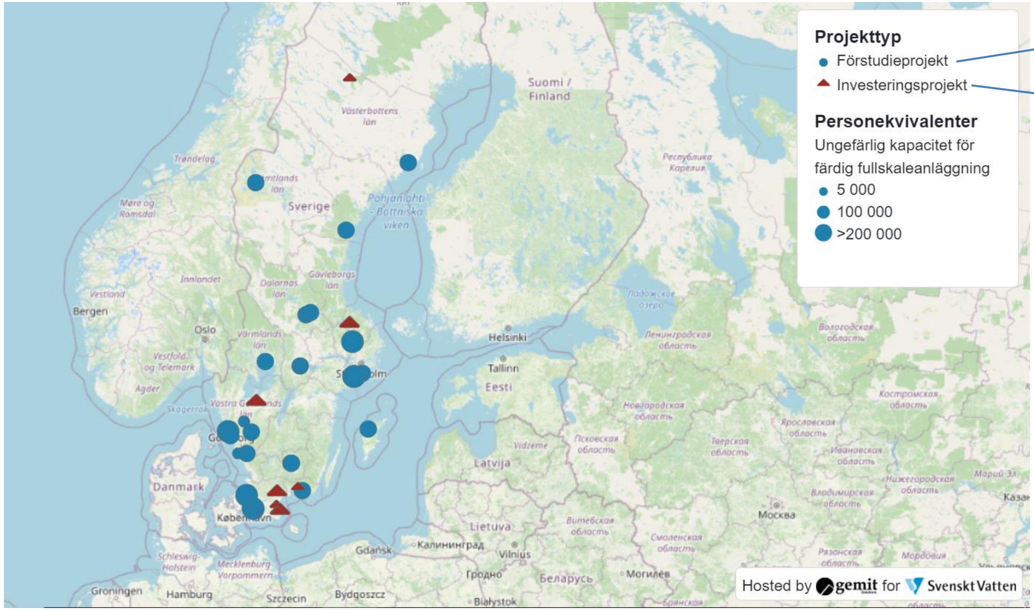
Treatment techniques for pharmaceuticals and micropollutants in wastewater

Description of eight projects that have received funding from the Marine and Aquatic Environment Grant for 2014-2017

Swedish Agency for Marine and Water Management report 2018:7

Background

Swedish EPA are supporting pre-studies and investments in full-scale plants



Feasibility studies

Full-scale investments

Involved in Swedish pilot plant

- Lund University, Department of Chemical Engineering
- Sweden Water Research AB
- Kristianstad University
- Svedala Municipality (hosting the plant)

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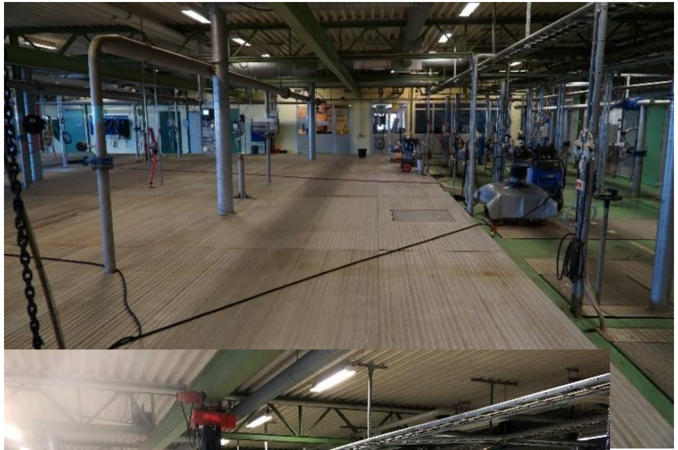
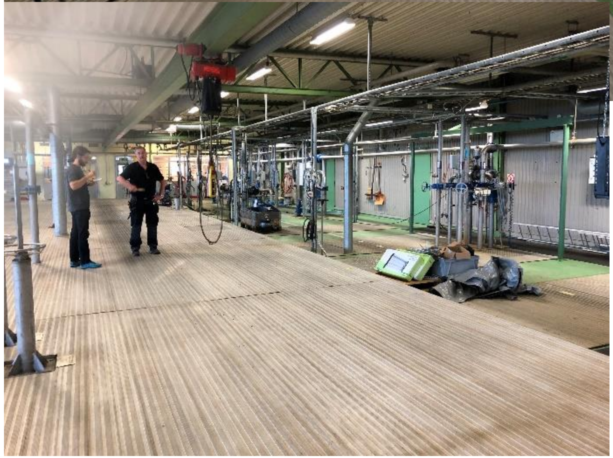
Wastewater treatment plant in Svedala

Loading: 12 000 PE (mainly domestic WW)
Biological and chemical wastewater treatment:

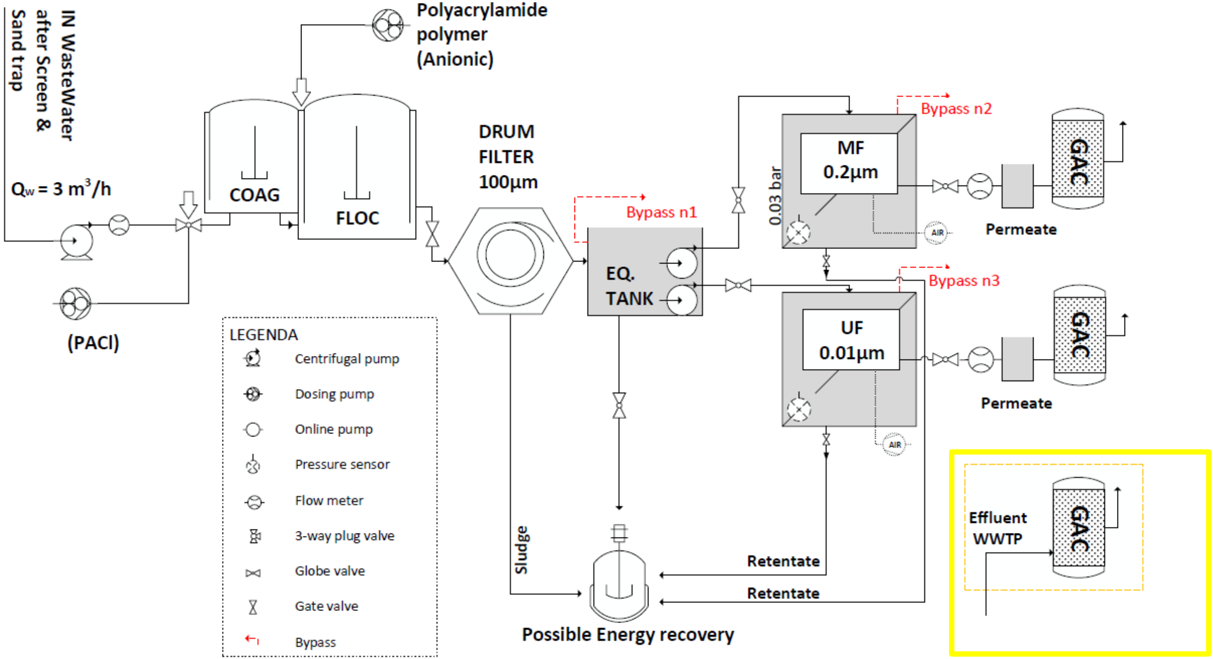
- No primary treatment
- Activated sludge (pre-denitrification)
- Post precipitation ($FeCl_3$) and tertiary settling

No anaerobic digestion of sludge





Pilot plant in Svedala

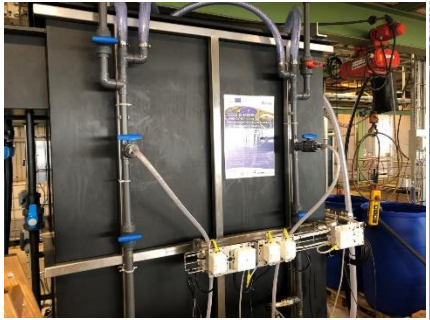


Two test lines:

1) Influent wastewater to direct membrane filtration (DMF) + GAC
2) Effluent wastewater to sand filter + GAC

Direct membrane filtration and GAC in Svedala

Membrane unit



GAC columns

Direct membrane filtration and GAC in Svedala

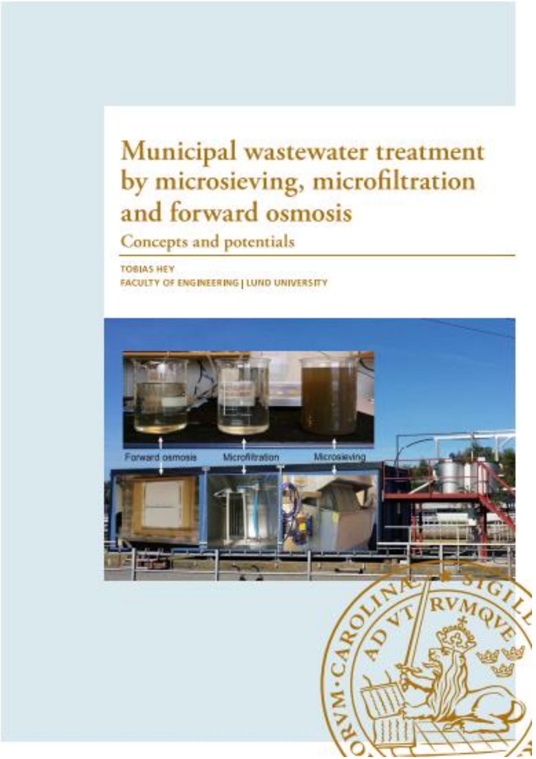
Direct membrane filtration and GAC in Svedala

By introducing microsieving and membranes early in the process line an improved treatment process and enhanced potential for reuse of energy and water could be expected

- Wastewater treatment ➔ high energy consumption
- Adding removal of organic micropollutants ➔ even higher energy consumption

Instead: separate organic matter and use it for generation of energy (biogas production)

and add GAC at the end



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Technical data

Chemically Enhanced Primary Treatment (Filtration)

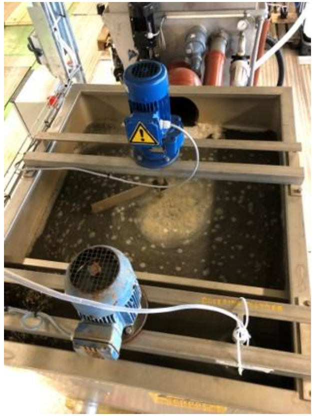
Direct Membrane Filtration

GAC Filtration

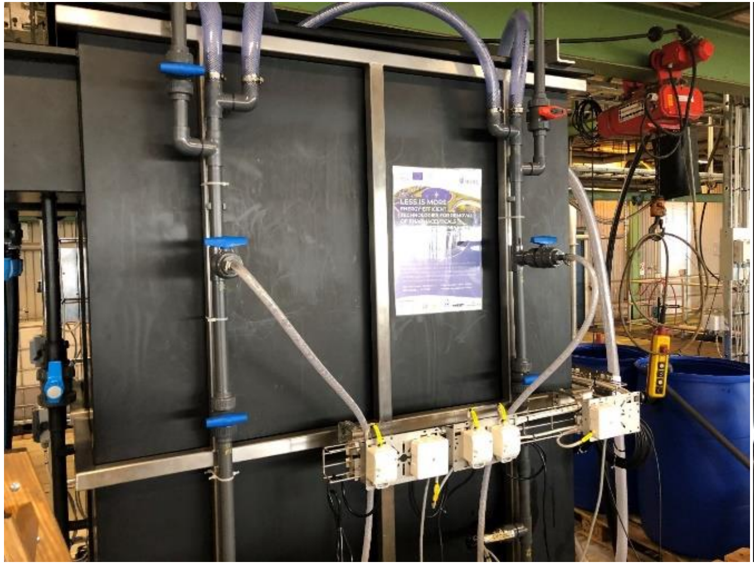
	Direct membrane filtration + GAC	Effluent GAC-filtration
Coagulation tank (m^3)	0.2	
Flocculation tank (m^3)	0.8	
Coagulant dosing	In pipe (5-15 mg Al^{3+}/L)	
Coagulant[a]	Polyaluminium chloride	
Polymer dosing	Overflow to floc. tank (1-4 mg/L)	
Polymer[b]	Anionic	
Drum filter[c] area (m^2)	0.33	
Pore filter opening (um)	100	
Filtration rate[d] (m/h)	8-9	
Equalization tank volume (m^3)	0.6	
Membrane tank dimensions (m)	H: 2.35, W: 0.5, D: 1.5	
Membrane surface area (m^2)	40	
Cut-off (MWCO) UF[e] (Da)	10 000	
Pore size MF[f] (µm)	0.2	
Design flux[d] (L/m^2h^{-1})	25	
GAC column height (m)	0.54	0.54
GAC column volume (L)	19	19
GAC cross section area (m^2)	0.04	0.04
Mass of carbon[g] per column (kg)	5.98	5.98
EBCT[d] (min)	10	10

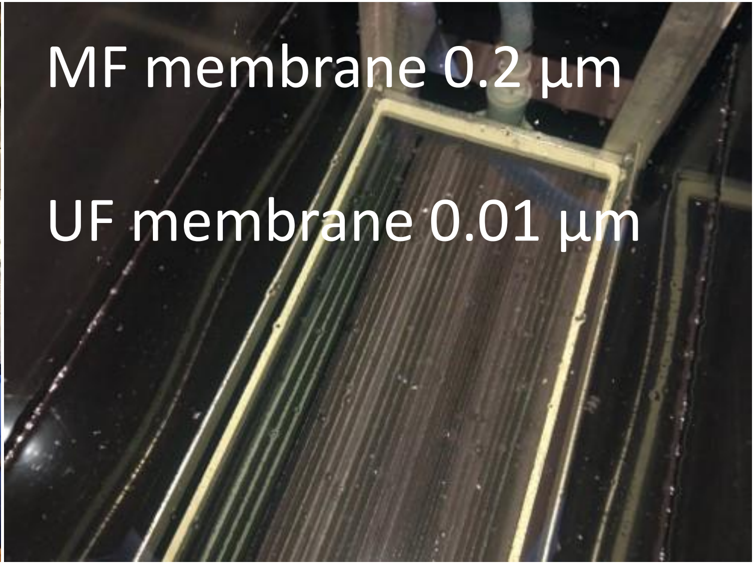
Chemically Enhanced Primary Filtration

CEPT based on microsieving previously developed (in cooperation) at Lund University



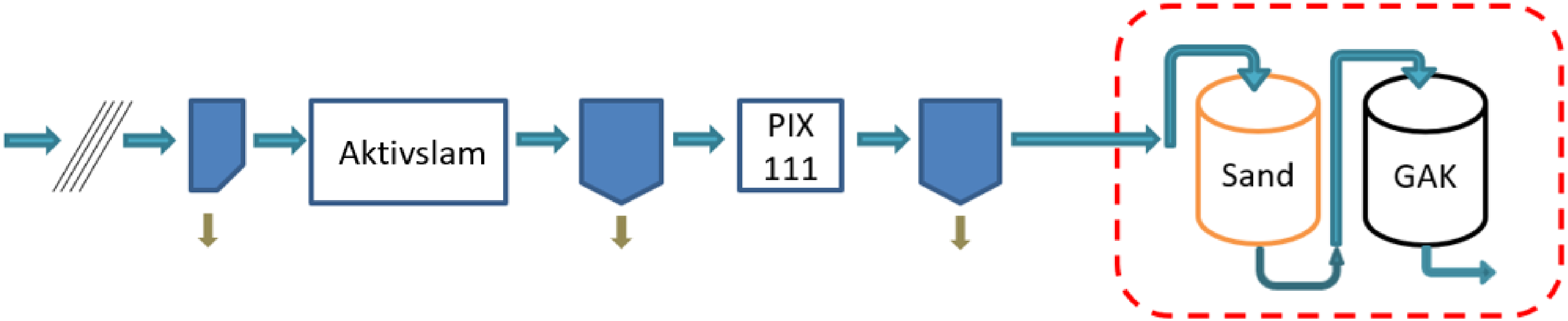
Membrane filtration





GAC columns

Effluent WW → Sand filter + GAC



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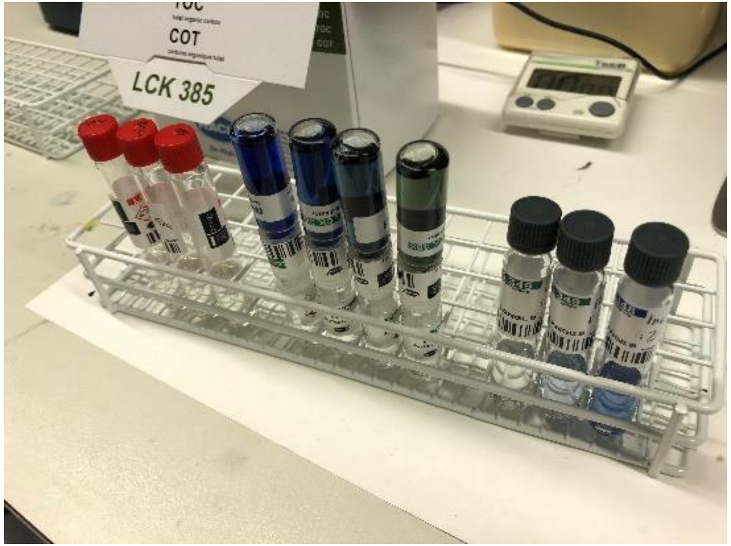
Analyses

Pharmaceuticals, biocides and other organic micropollutants – reflecting Watch lists and other compilations of relevant indicators



Ämnen för utvärdering av avancerad reningsteknik

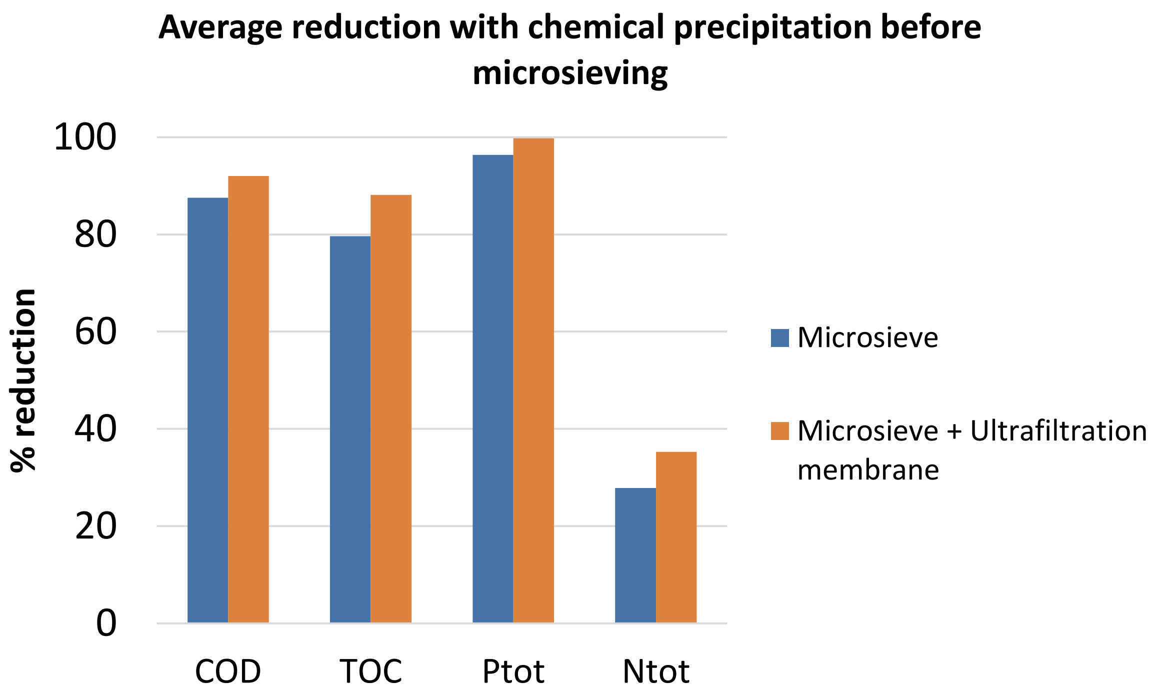
Listan är baserad på ämnen upptagna på EUs 1st Watchlist och Läkemedelsverkets lista från 2015. Ämnesurvalet täcker väl in en rad aspekter som är viktiga vid utvärdering av avancerad rening såsom; halter (hög och låg), varierade kemiska egenskaper och relevans ur ett miljö- och hälsoperspektiv.

1 Acetamiprid
2 Atenolol
3 Bisphenol A
4 Carbamazepine
5 Ciprofloxacin
6 Citalopram
7 Clarithromycin
8 Diclofenac
9 Erythromycin
10 Estrone
11 Fluconazole
12 Furosemide
13 Ibuprofen
14 Imidacloprid
15 Ketoconazole
16 Losartan
17 Methotrexate
18 Metoprolol
19 Naproxen
20 Oxazepame
21 Paracetamol
22 PFOA
23 PFOS
24 Propranolol
25 Sertraline
26 Sulfamethoxazole
27 Tramadol
28 Trimethoprim
29 Venlafaxine
30 Zolpidem

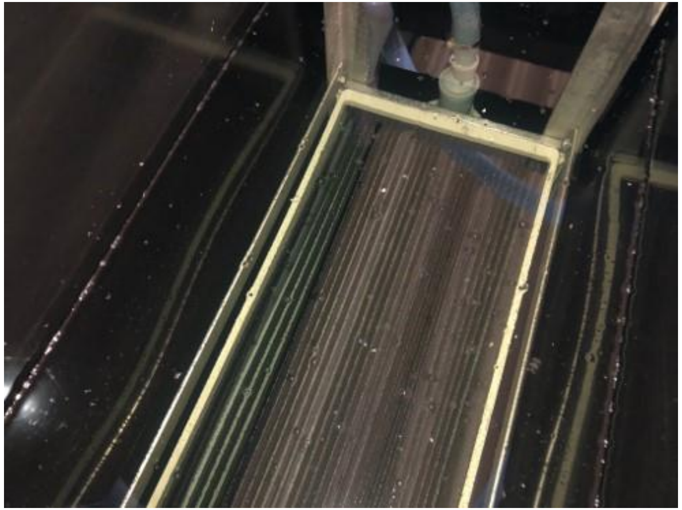
MoLab, Högskolan Kristianstad
Ola Svahn och Erland Björklund

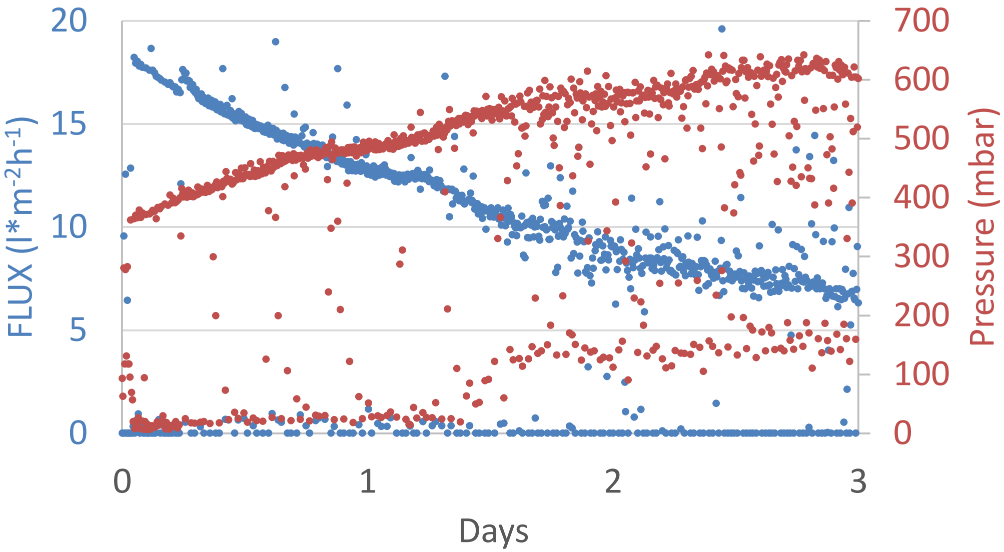
Results DMF line

- High reduction of organic matter and phosphorus
- Moderate reduction of nitrogen
- Chemicals + microsieving is very efficient



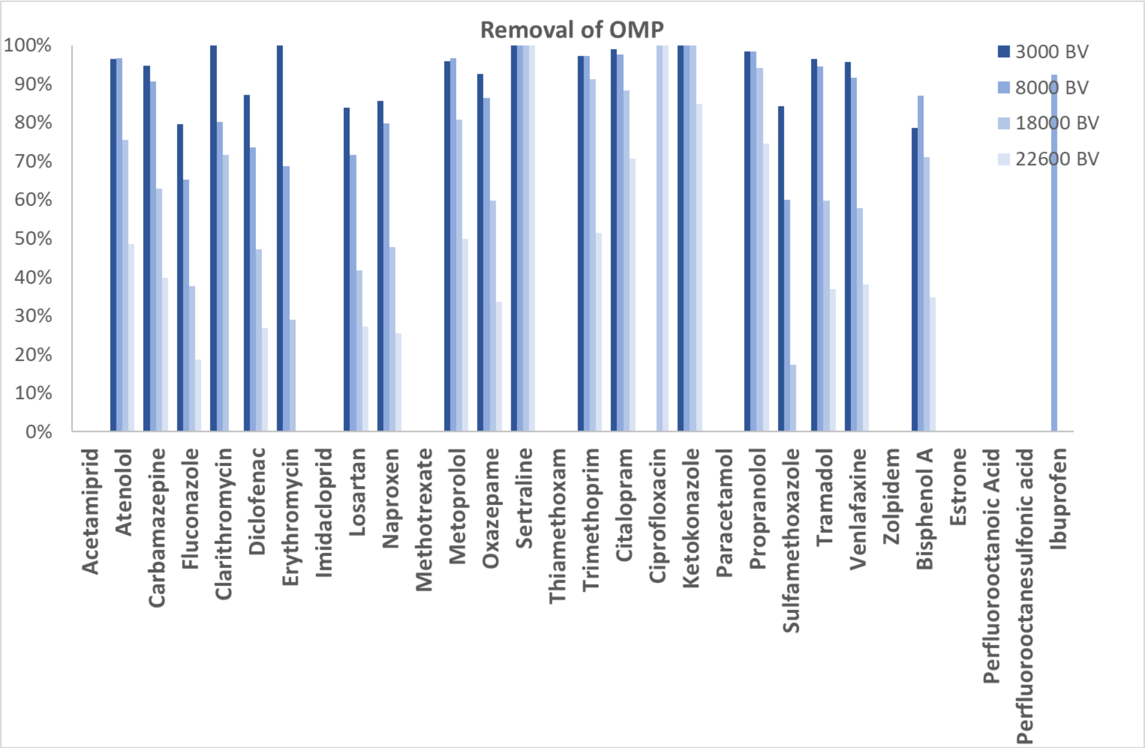
Fouling of membranes ➔ no long-term operation of GAC





Short-term GAC after UF ➔ 98-100% removal of organic micropollutants
As expected no removal in membrane filtration part

Results – effluent GAC

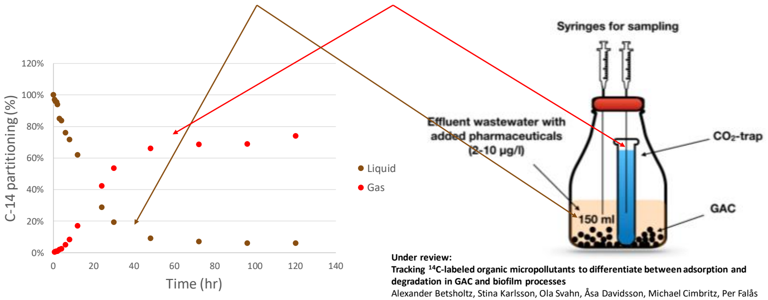


Other studies

- Studies of interactions and separation mechanisms in GAC-filters using liquid scintillation
- Estimation of biogas potentials for DMF solutions
- Coagulation/flocculation, membrane filtration and adsorption studies in laboratory scale
- Pathogen removal study

Degradation or adsorption in GAC?

- Measuring ^{14}C-decay in **liquid** and **gas phases (CO_2-trap)**



Under review:
Tracking ^{14}C-labeled organic micropollutants to differentiate between adsorption and degradation in GAC and biofilm processes
Alexander Betsholtz, Stina Karlsson, Ola Svahn, Åsa Davidsson, Michael Cimbritz, Per Falås

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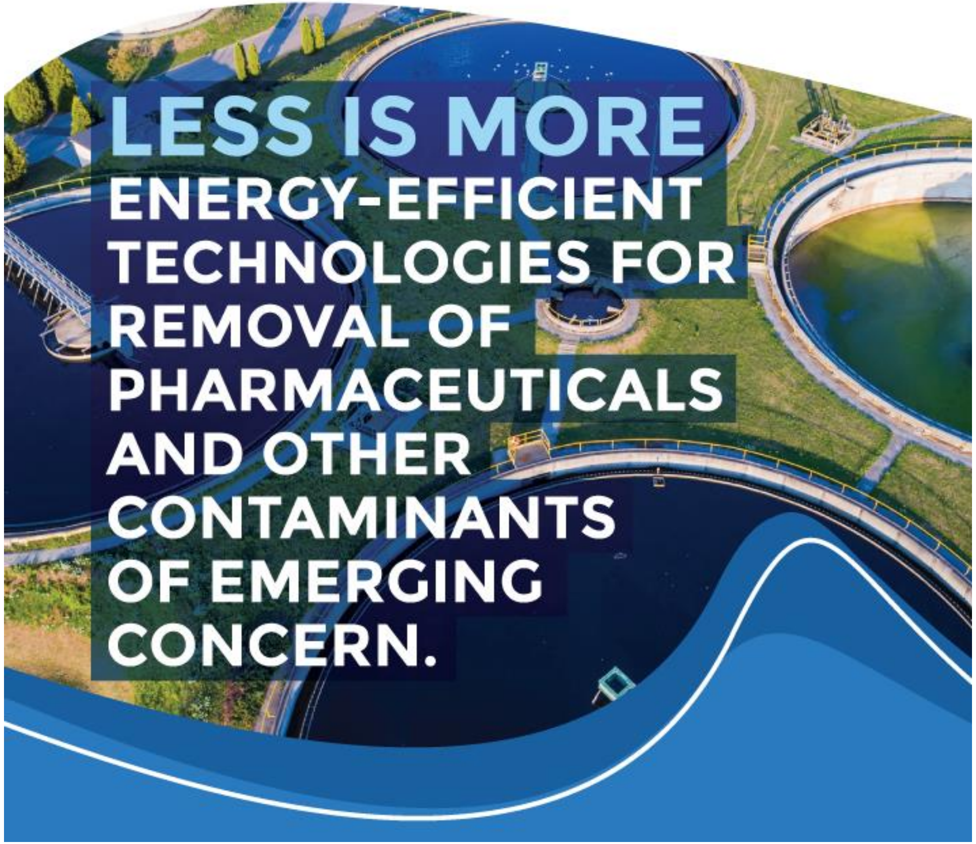
QUESTIONS?



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