

Renewable granular active carbon for removal of organic micropollutants in urban wastewater

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Fachhochschule
Nordwestschweiz



**ABWASSERVERBAND
ALTENRHEIN**



GAC pilot experiment

GOALS:

1. to produce renewable GAC with similar performances as commercially available GAC
2. to test renewable GACs for the elimination of organic micropollutants (OMPs) in urban wastewater at pilot scale experiment

APPROACH:

1. Laboratory and pilot experiments to investigate the effect of pyrolysis and activation on GAC performances
2. Definition of the conditions for pyrolysis and activation of 2 renewable resource for GAC production
3. Production of renewables GAC
4. Operation of GAC filter (Pilot plant at AVA Altenrhein) for 8-12 months



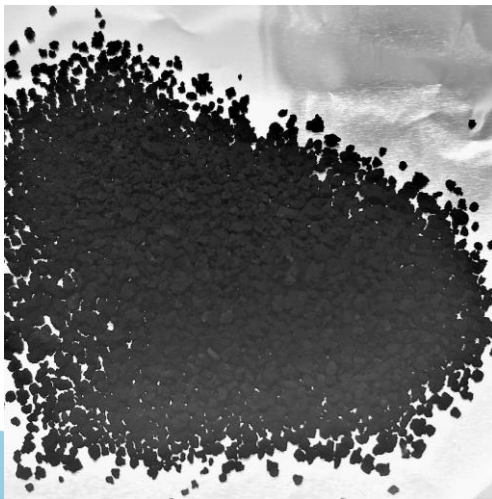
Production of renewable GACs

Phase	Objective
Pilot trials (Pyreka, Agroscope)	<p>To generate samples under different conditions:</p> <ul style="list-style-type: none">• 2 renewable resources (CP, SS)• Temperature of pyrolysis and activation (700, 800, 900°C)• Activation gas (CO₂, H₂O)• Residence time (10, 20, 30') <p style="text-align: right;">21 samples in total</p>
Characterization of samples	<p>To define physical properties and performances:</p> <ul style="list-style-type: none">• Yield of production• Particle size distribution• Density• Hardness• Specific surface, and porous size distribution• Adsorption (saK254, OMPs)

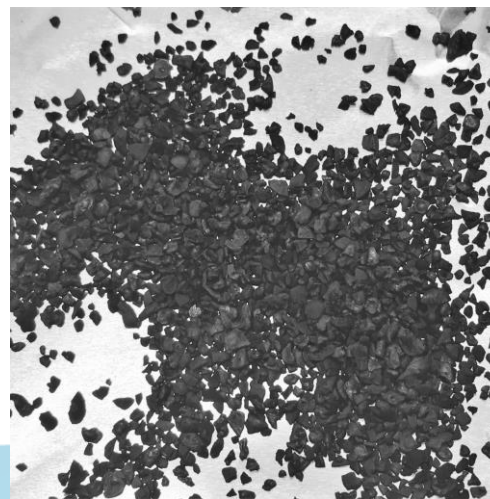


The GACs

Sample name	Cond.	SAK adsorption [%]	total area [m ² /g]	total porous volume [m ³ /g]	PB hardness [%]	tap density [kg/m ³]	Production yield [%]
SS GAC	CO ₂ _800°C	9	46	0.176	87	592	50
CP GAC	H ₂ O_900°C	17	678	0.398	63.3	260	13
401V	-	23	Unk.	Unk.	>90	490	Unk.



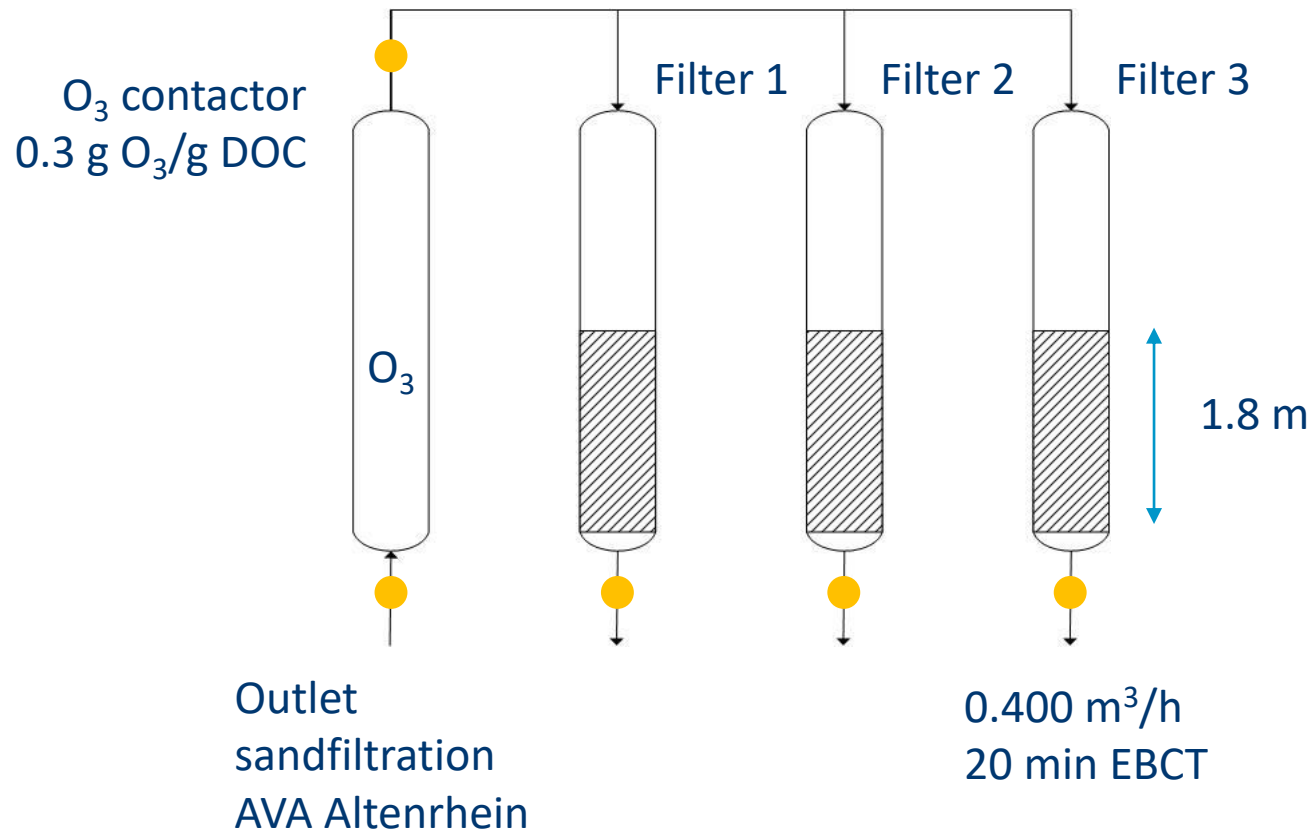
SS_GAC



CP_GAC



The pilot plant



- Filter 1 Chemviron 401V (401V)
- Filter 2 Cherry pit GAC NextGen (CP Nextgen)
- Filter 3 Sewage sludge GAC NextGen (SS Nextgen)
- Sampling point





GAC pilot plant

Geometry of the filters

Diameter of the column	m	0.3
Height of GAC_the fixed bed contactor	m	1.8
Volume of the fixed bed contactor	m ³	0.127
mass of SS_GAC	kg	67
mass of CP_GAC	kg	33
mass of 401V	kg	62

Analytics

SPE - LC MS for organic micropollutants OMP elimination

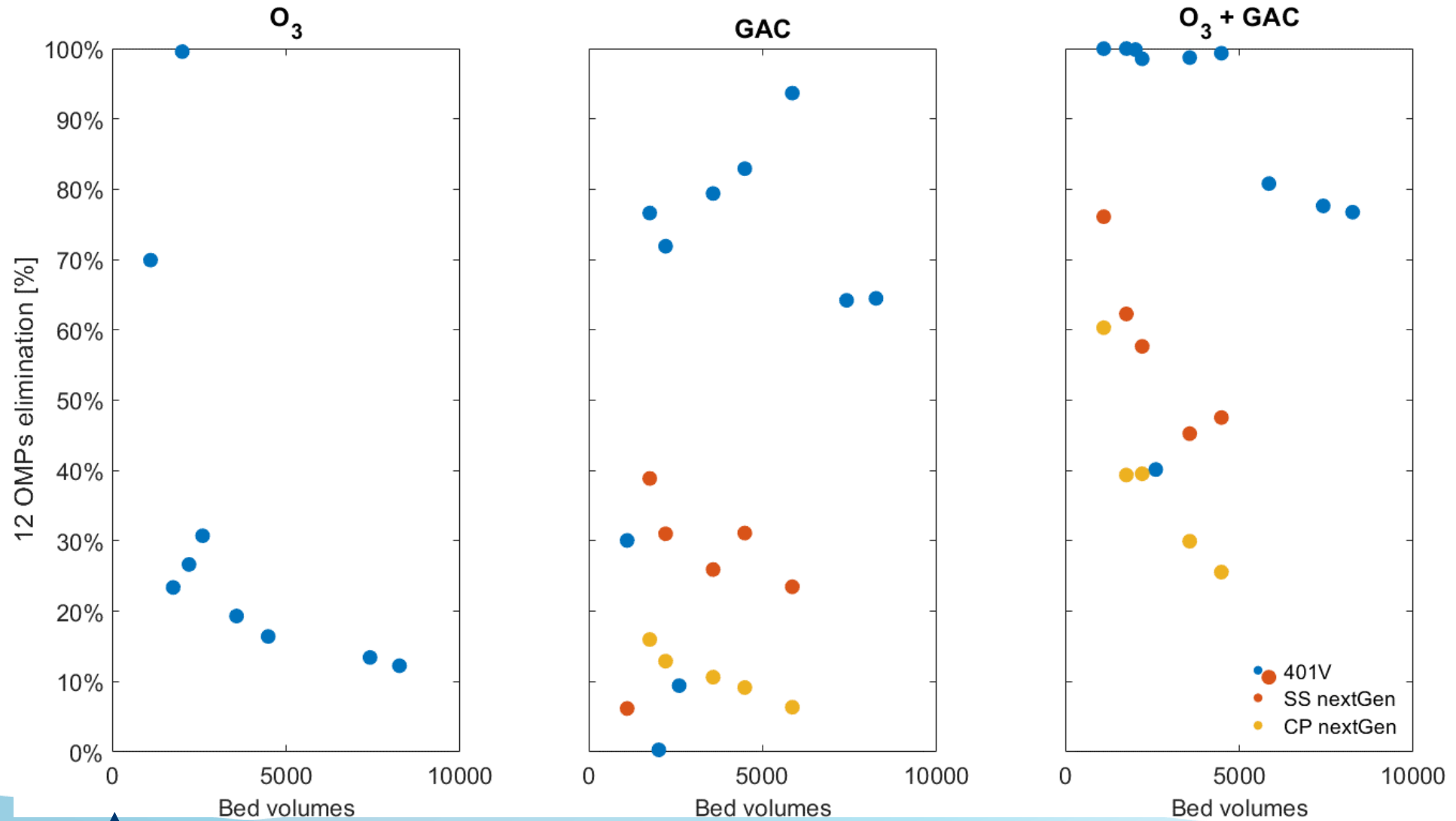
Sak254 and DOC as proxy for OMPs



- Automated backwashing system
- Automated sampling at the outlet



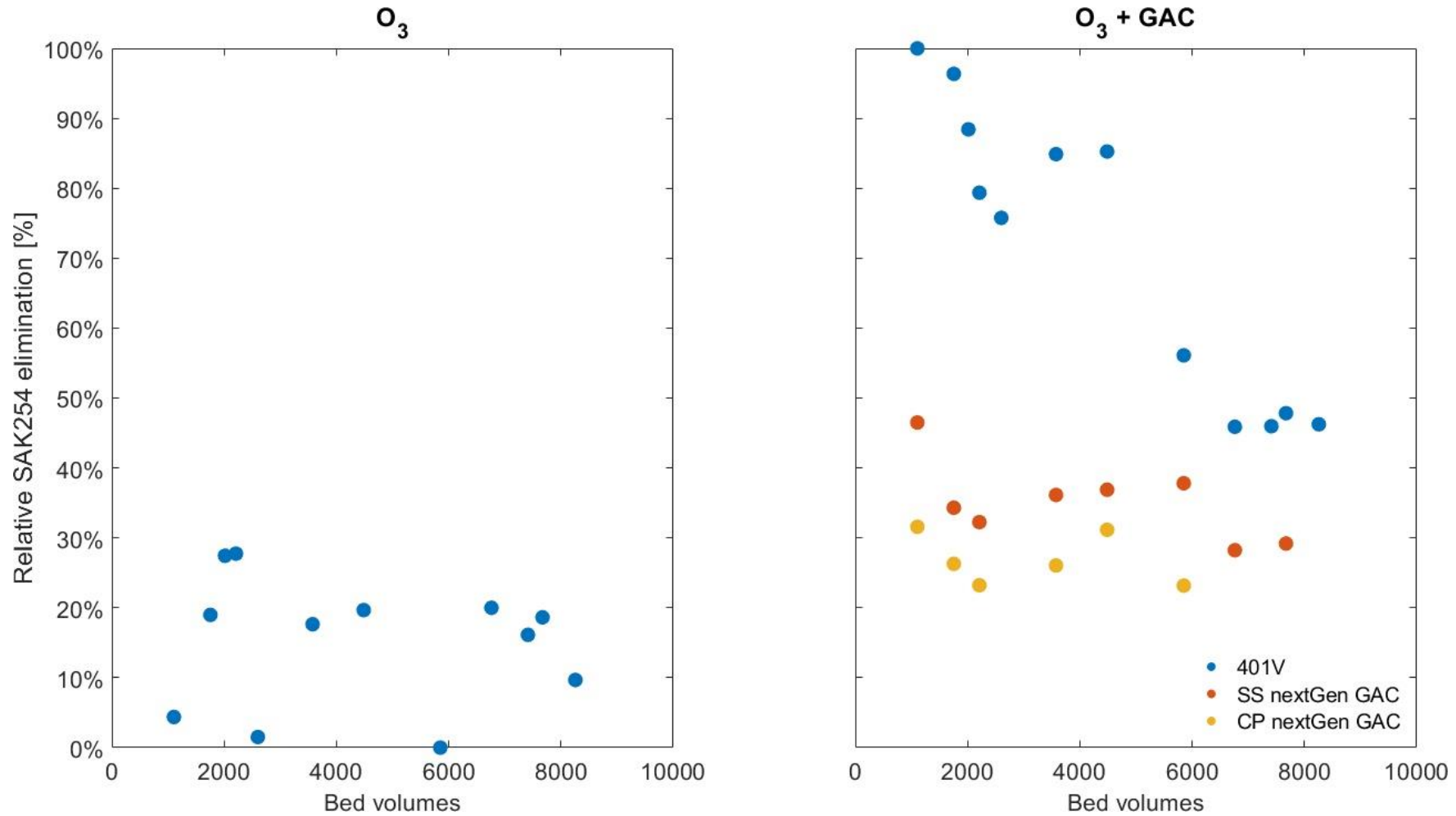
Pilot study - 12 OMPs elimination



Nov 2020



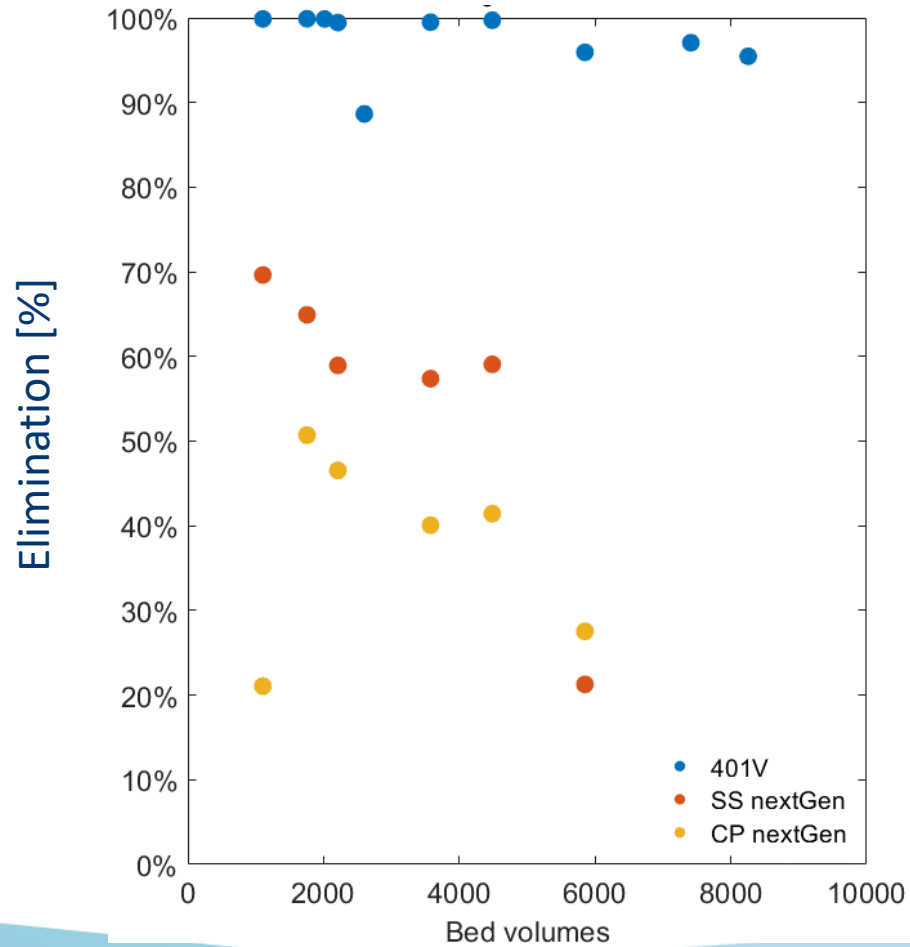
Pilot study - Relative sak254 elimination



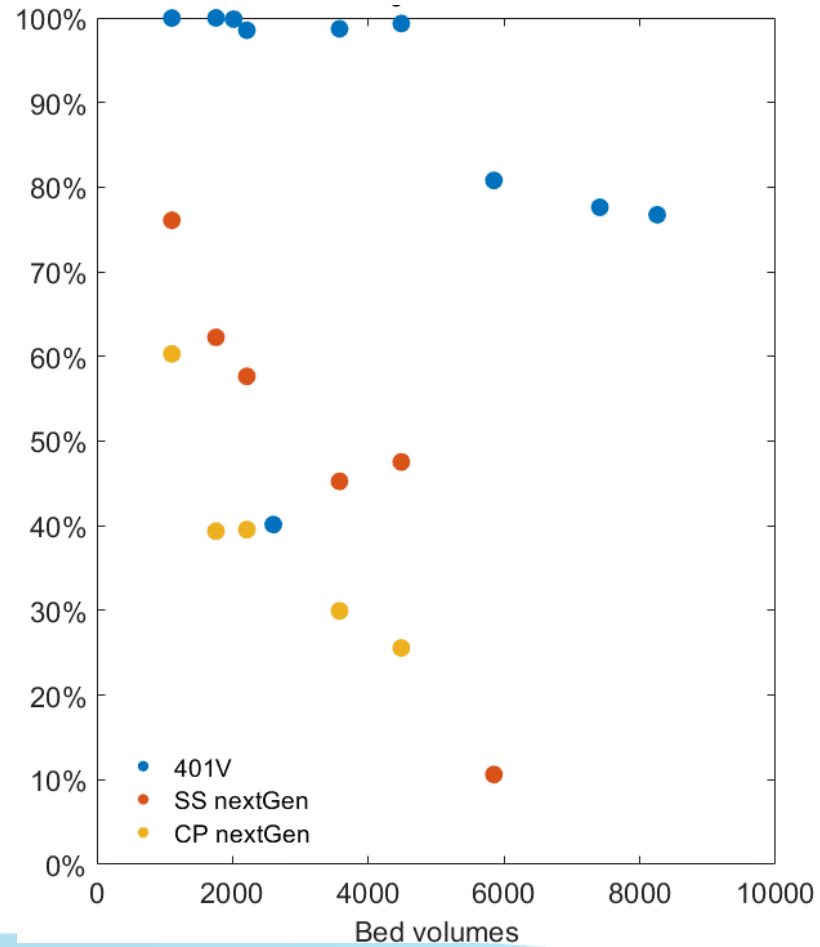


Pilot study - the «worst case» OMPs elimination

12 OMPs



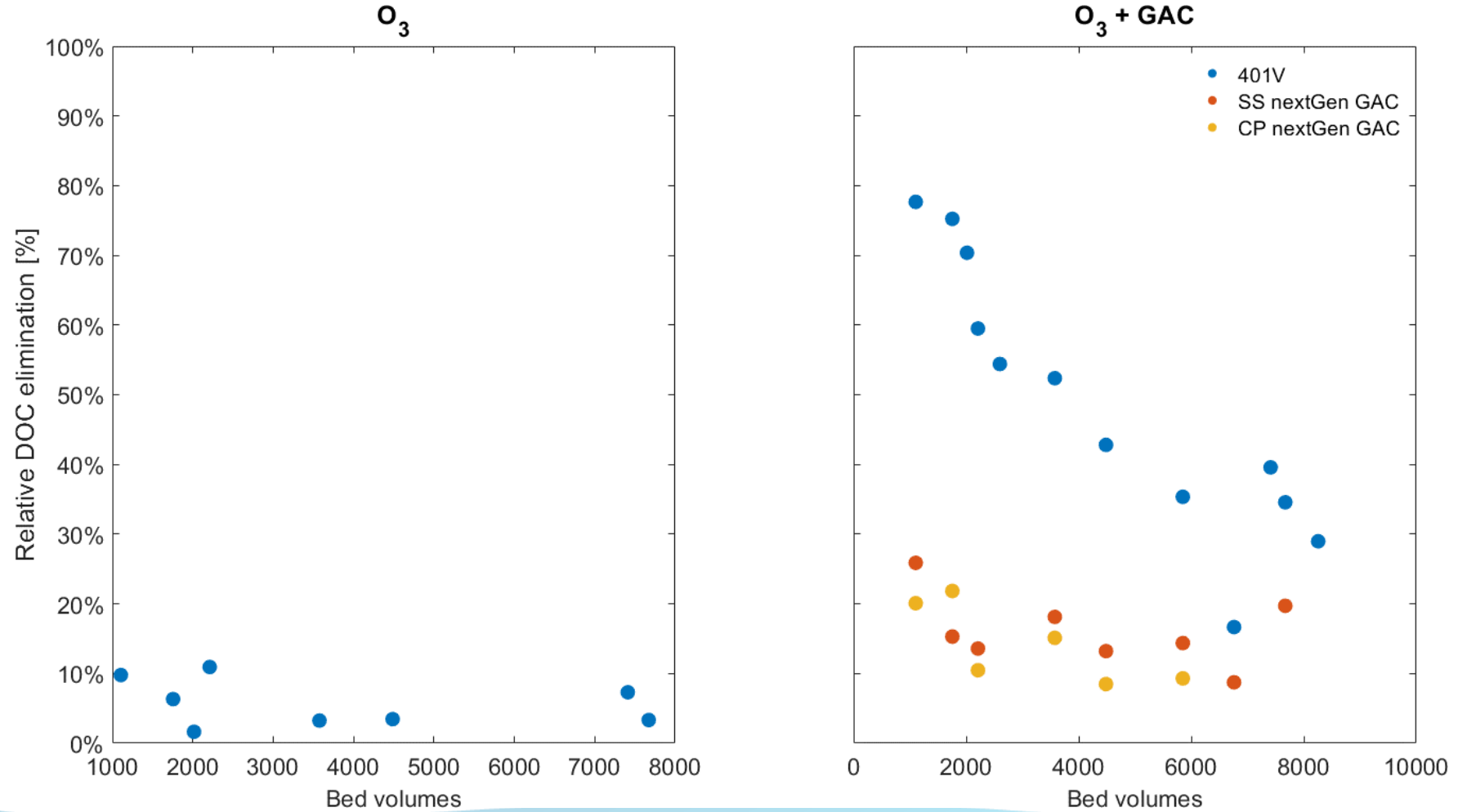
worst case OMPs



1. Venlafaxin
2. Candesartan
3. Irbesartan

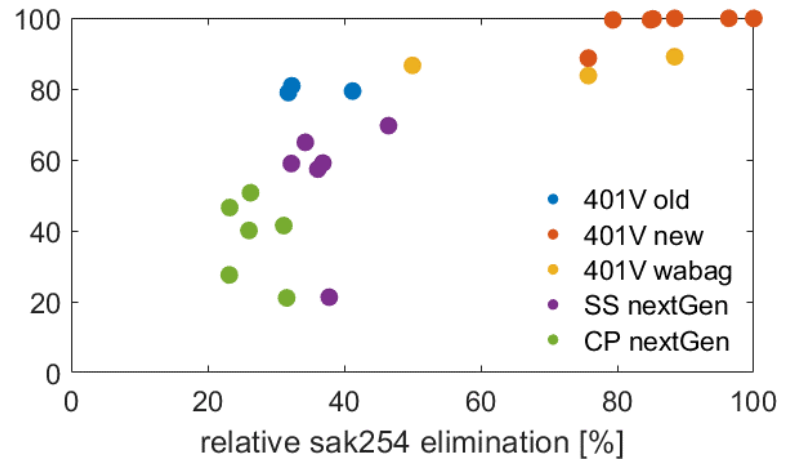
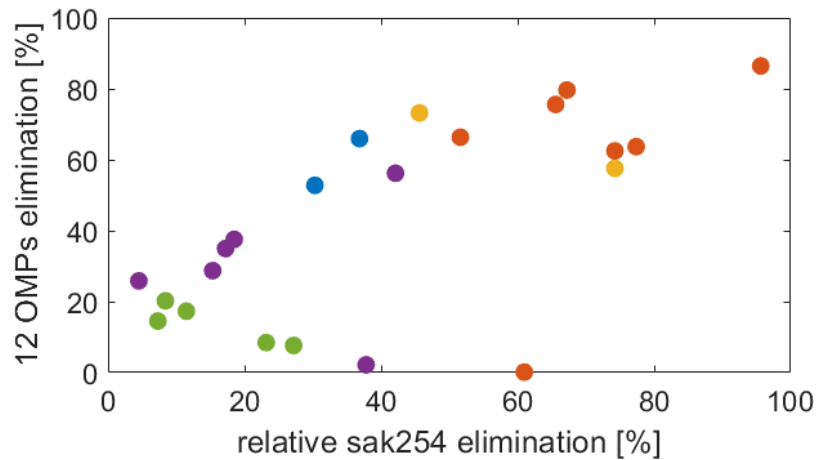
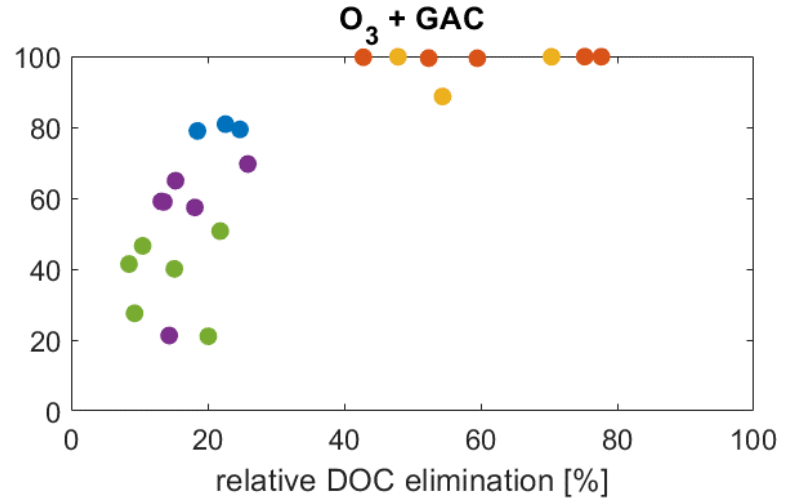
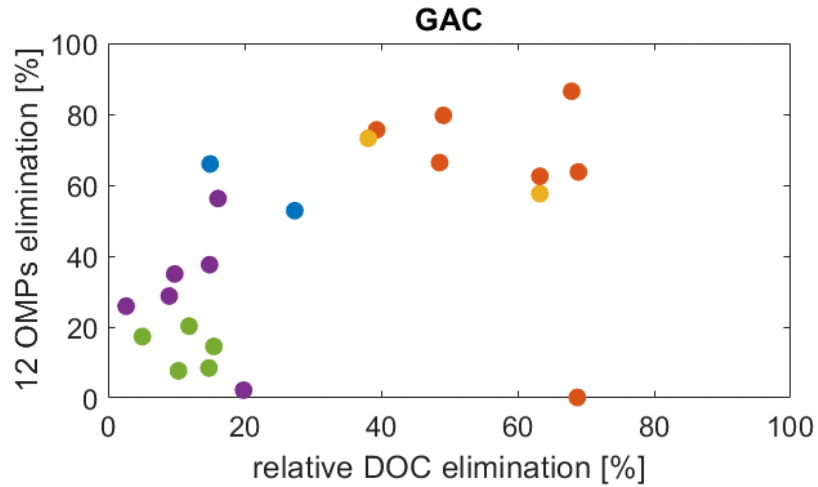


Pilot study - Relative DOC elimination





Pilot study - DOC/OMP & sak/OMP correlation





Conclusions

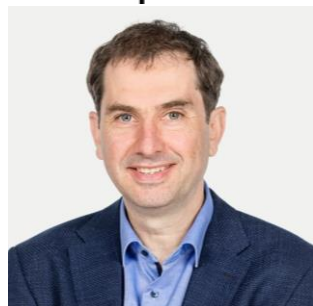
- We identified 2 GAC from renewables sources to be tested at pilot scale
- After 5 months of operation, the first results indicate successful elimination of OMPs via GAC filter
- Standard operating conditions do not ensure sufficient elimination as demanded in Swiss ordinance (i.e. 80% elimination). Operating conditions of the filters should be optimized (EBCT and O₃ dosage)
- Sak254 and DOC are useful but not accurate proxy for OMP elimination. Direct measurements of OMP is always preferable.



Thank you for your attention!



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