MICROPOLLUTANT REMOVAL PILOT PLANT IN TURKU

TURKU REGION WASTEWATER TREATMENT PLANT LTD.

14.5.2025

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THEMES OF THE PRESENTATION

- TURKU REGION WASTEWATER TREATMENT PLANT LTD.
- PILOT CONTAINER ARRIVAL 19.2.2025
- PILOT TESTS AND OPERATION
- RESULTS
- FUTURE PLANS

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TURKU REGION WASTEWATER TREATMENT PLANT LTD.

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PARTNER MUNICIPALITIES AND OWNERSHIP

Wholesale company owned by

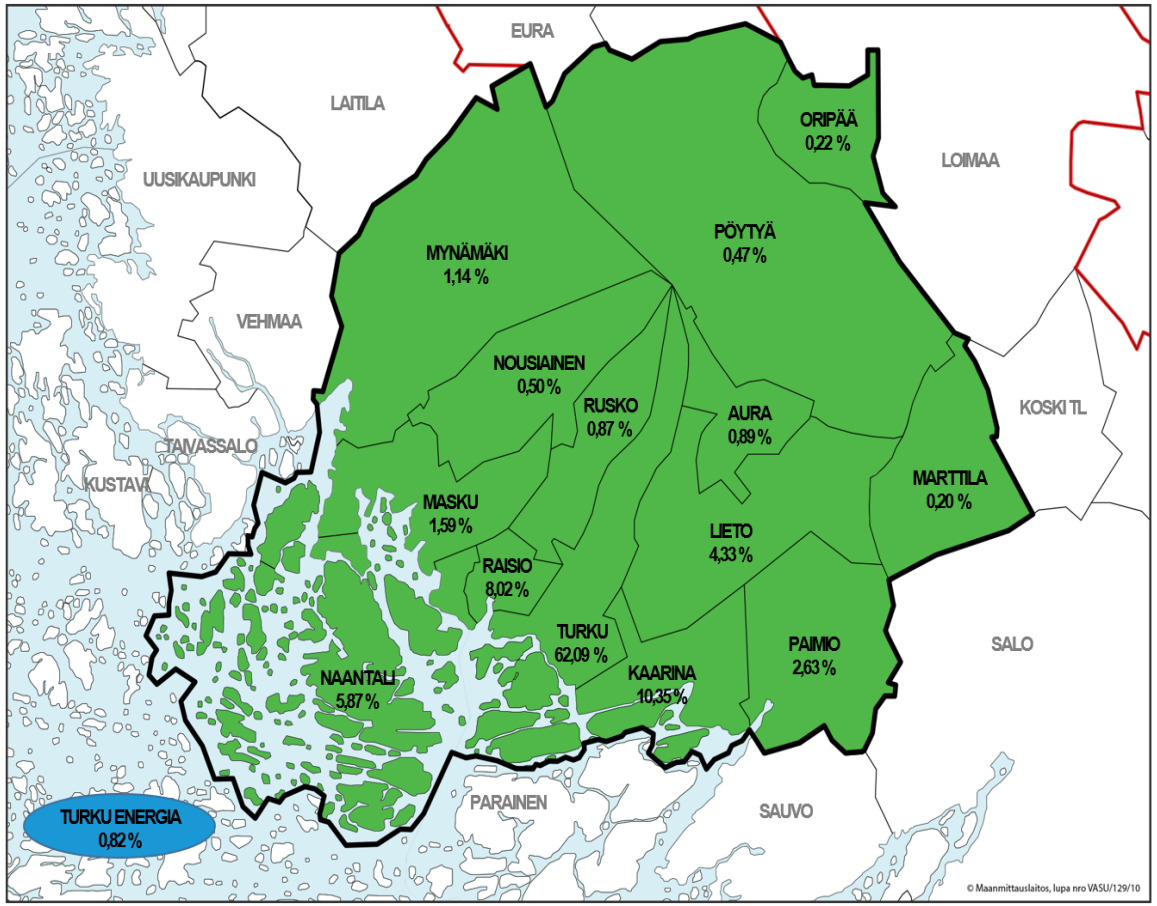
- 14 municipalities in Turku region in South-Western Finland, **wastewater treatment services**
- local energy company, **heat recovery services**

- Ensures **efficient and high-quality wastewater treatment** for the 300,000 inhabitants and the industrial in the region

- Part of Turku city group



(maps.google.com)



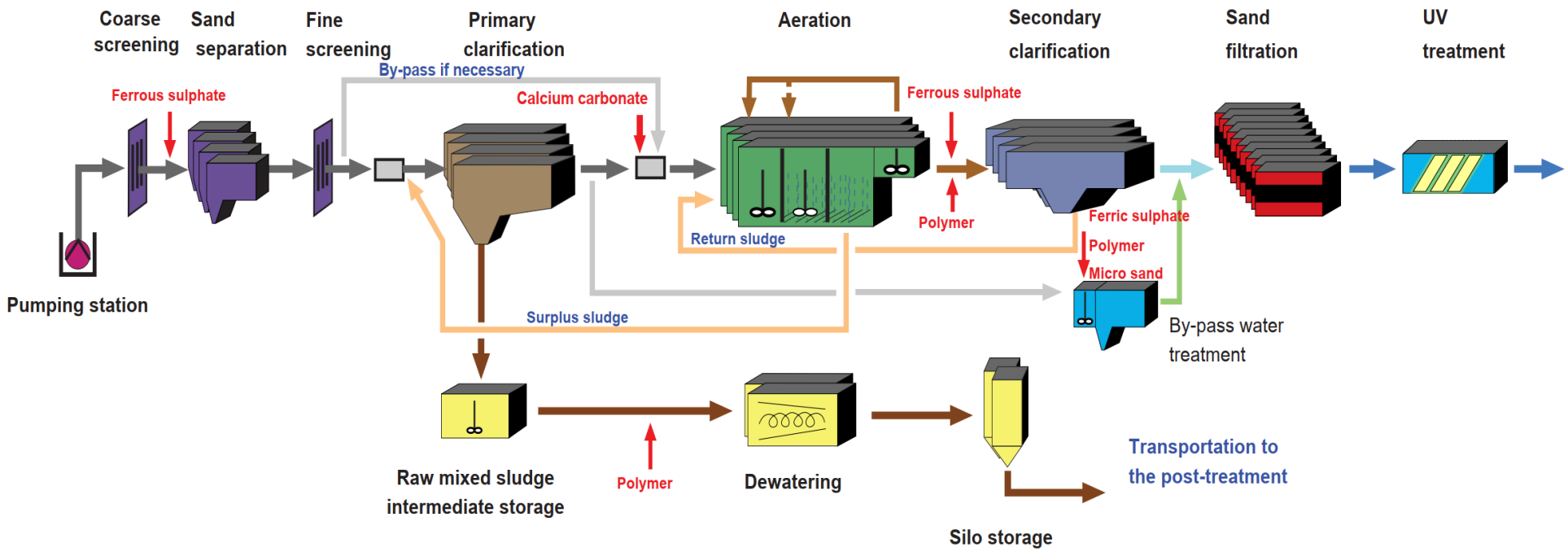
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- WWTP is located in the solid rock of Kakolanmäki hill in the middle of Turku city.
- Vibrant urban community around and above the WWTP.

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PROCESS DIAGRAM



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PILOT CONTAINER ARRIVAL 19.2.2025

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GROUP
TURVALLISUUS
ON VÄLITTÄMISTÄ


MOBILE ADVANCED TECHNOLOGY FOR MICROPOLLUTANT REMOVAL FROM WATER
EMPEREST PROJECT – ELIMINATING MICRO-POLLUTANTS FROM EFFLUENTS FOR REUSE STRATEGIES



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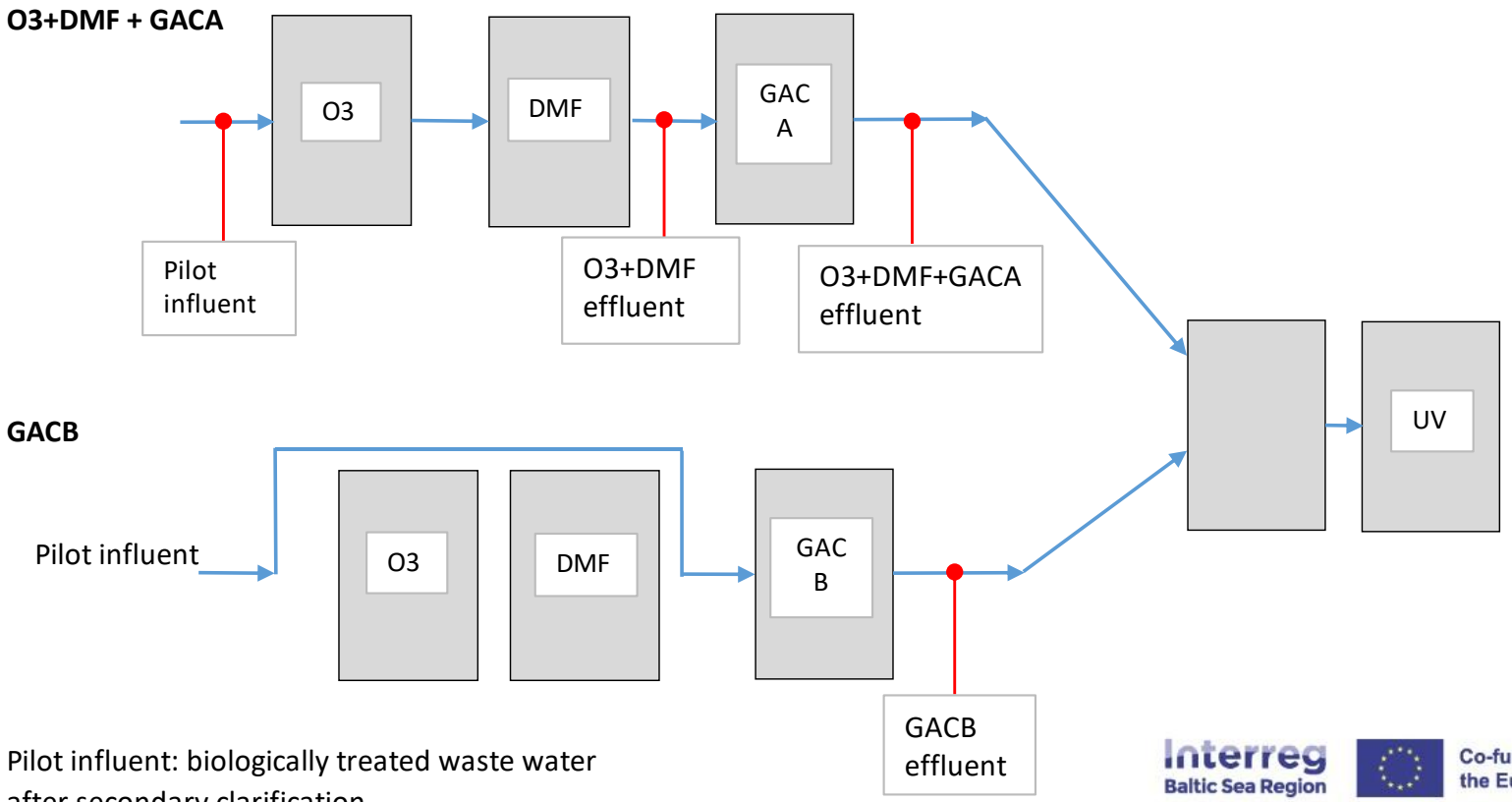

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PILOT TESTS AND OPERATION

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PILOT TEST AND OPERATION

BASIC TEST RUNS TWO PARALLEL LINES - SAME INFLUENT WATER



Pilot influent: biologically treated waste water after secondary clarification

- Zero samples are taken from the inlet of the pilot container
  - influent biologically treated wastewater
- After the different process steps, reference samples are taken to detect the effectiveness of the unit operations
- Two parallel GAC lines: GACA with ozone and sand filtration and GAB
- All samples are analyzed in an accredited laboratory

Interreg Baltic Sea Region
Co-funded by the European Union
SUSTAINABLE WATERS EMPEREST
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PILOT TEST AND OPERATION

- Test runs have been carried out with different parameters
  - Ozone contact time 5 min – 10 min
  - GAC contact time 10,8 min – 13,8 min – 19,4 min – 24,2 min – 32,3 min

- Samples have been taken twice a week, the first of which is always the use of the container with standard settings
  - Ozone contact time 5 min & GAC contact time 19,4 min

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LABORATORY ANALYSIS

PFAS µg/l
1H,1H,2H,2H-Perfluoro-oktaanisulfonaatti (6:2 FTS)
1H,1H,2H,2H-Perfluorodekaanisulfonaatti (8:2 FTS)
1H,1H,2H,2H-Perfluoroheksaanisulfonaatti (4:2 FTS)
8:2 Fluorotelomer unsaturated carboxylic acid (8:2 FTUCA)
Perfluoro-oktaanidekaanihappo (PFODA)
Perfluoro-oktaanihappo (PFOA)
Perfluoro-oktaanisulfonaatti (PFOS)
Perfluorobutaanihappo (PFBA)
Perfluorobutaanisulfonaatti (PFBS)
Perfluorodekaanihappo (PFDA)
Perfluorodekaanisulfonihappo (PFDS)
Perfluorododekaanihappo (PFDoA)
Perfluorododekaanisulfonihappo (PFDoS)
Perfluoroheksaanihappo (PFHxA)
Perfluoroheksaanisulfonaatti (PFHxS)
Perfluoroheptaanihappo (PFHpA)
Perfluoroheptaanisulfonaatti (PFHpS)
Perfluorohexadecanic acid (PFHxDA)
Perfluorononaanihappo (PFNA)
Perfluorononaanisulfonihappo (PFNS)
Perfluoropentaanihappo (PFPeA)
Perfluoropentaanisulfonihappo (PFPeS)
Perfluorotetradekaanihappo (PFTA)
Perfluorotridekaanihappo (PFTrDA)
Perfluorotridekaanisulfonihappo (PFTrDS)
Perfluoroundekaanihappo (PFUnA)
Perfluoroundekaanisulfonihappo (PFUdS)
PFAS 20 -Sum parameter (STM 2015/1352)
Perfluoro-1-heksaanisulfonamidi (FHxSA)
Perfluoro-oktaanisulfonamidi (PFOSA)
Perfluorobutaanisulfonamidi (PFBSA)

Pharmaceuticals µg/l
4/6-methyl-1H-benzotriatzole
Amisulprid
Benzotriazole
Diclofenac
Hydrochlorothiazide
Irbesartan
Candesartan
Carbamazepine
Clarithromycin
Metoprolol
Citalopram (+escitalopram)
Venlafaxine

PFAS short chain ng/l
PFEtS (Perfluorietaanisulfonihappo) - (ng/l)
PFPrA (Perfluoropropaanihappo) - (ng/l)
PFPrS (Perfluoripropaanisulfonihappo) - (ng/l)
TFA (Trifluorietikkahappo) - (ng/l)
TFMS (Trifluorimetaanisulfonihappo) - (ng/l)
Other extra analyses
CODCr - (mg O2/l)
Suspended solids (GF/A) - (mg/l)
Total orcanic carbon (TOC) - (mg/l)
Bromate (BrO3) - (mg/l)
Bromide (Br-) - (mg/l)
Terbutryn - (µg/l)

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RESULTS AND FUTURE PLANS

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RESULTS - Ozonation

- Most pharmaceuticals are removed with over 80% efficiency compared to biologically treated water

- The concentrations of long-chain PFAS compounds decreased and those of short-chain ones increased during ozonation

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RESULTS - GAC

- 4/6-methyl-1H-benzotriazole, Diclofenac, Carbamazepine, Metoprolol, Venlafaxine: removal efficiency has been 90-100%

- The treatment efficiency of candesartan decreased steadily during the experimental period, reaching 67 % (test 16.4.2025), when approximately 2000 bed volumes (BV) treated with the same activated carbons. Treatment efficiency continued decreasing (test 7.5.2025)

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RESULTS - GAC

- The cleaning efficiency of PFAS compounds during the first weeks was on average about 90% (sum parameter PFAS20)

- GAC is not effective against short-chain PFAS compounds (C1-3, e.g. TFA)

- So far, no major differences in removal efficiency of PFAS have been seen with different contact times (10 – 30 minutes)

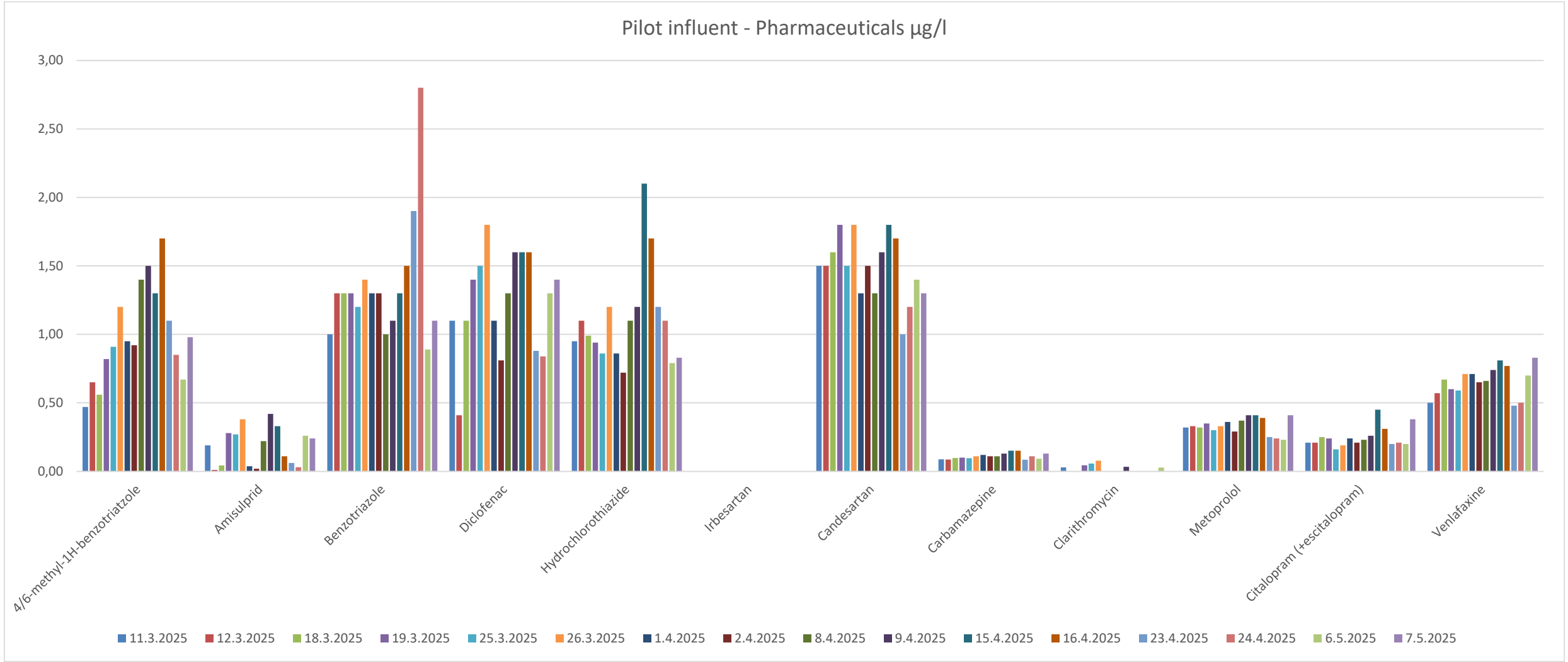
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RESULTS – Ozonation + GAC

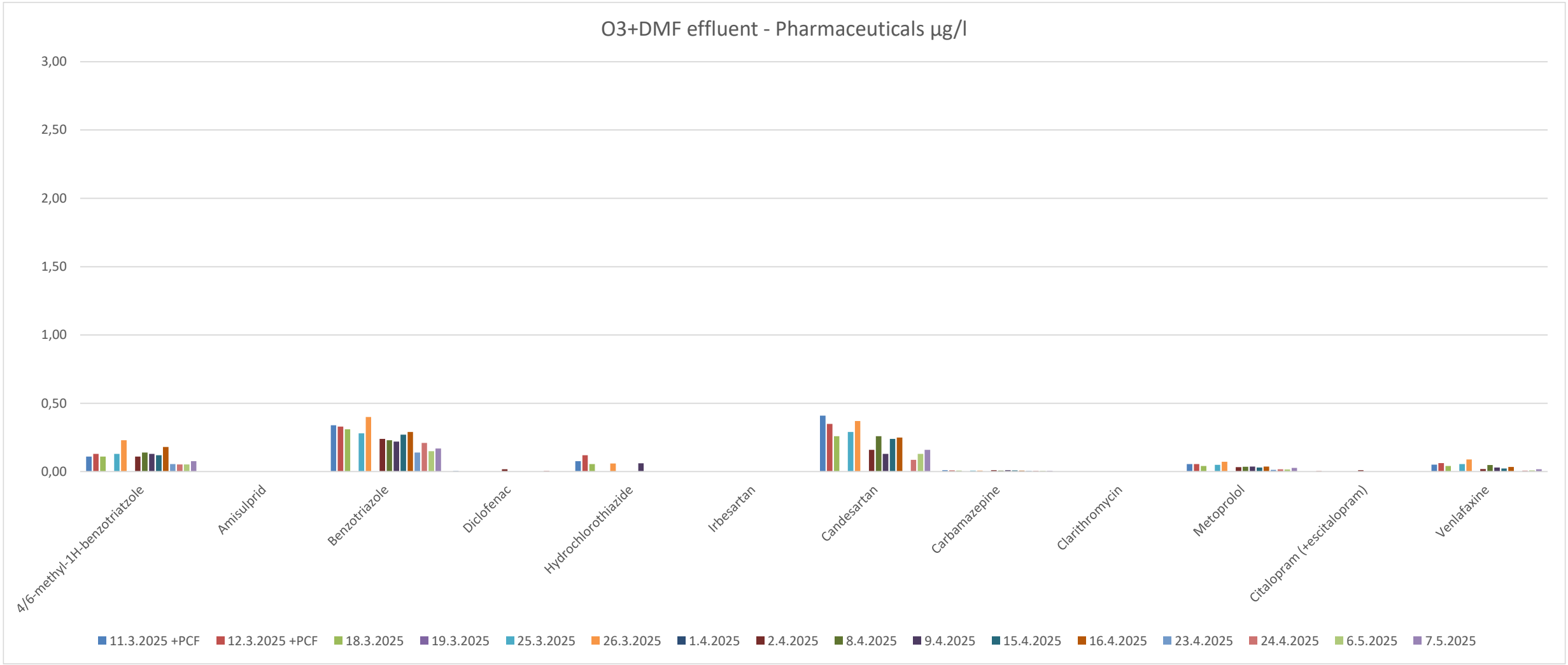
- Ozone before GAC seems to improve GAC's operation especially when GAC bed volumes / operating time increases
- Ozonation + GAC: Removal of pharmaceuticals has been 100 % in all pilot test (11.3. – 7.5.) regardless of GAC's bed contact time
- However ozonation did not significantly improve the performance of GAC in removing PFAS compounds

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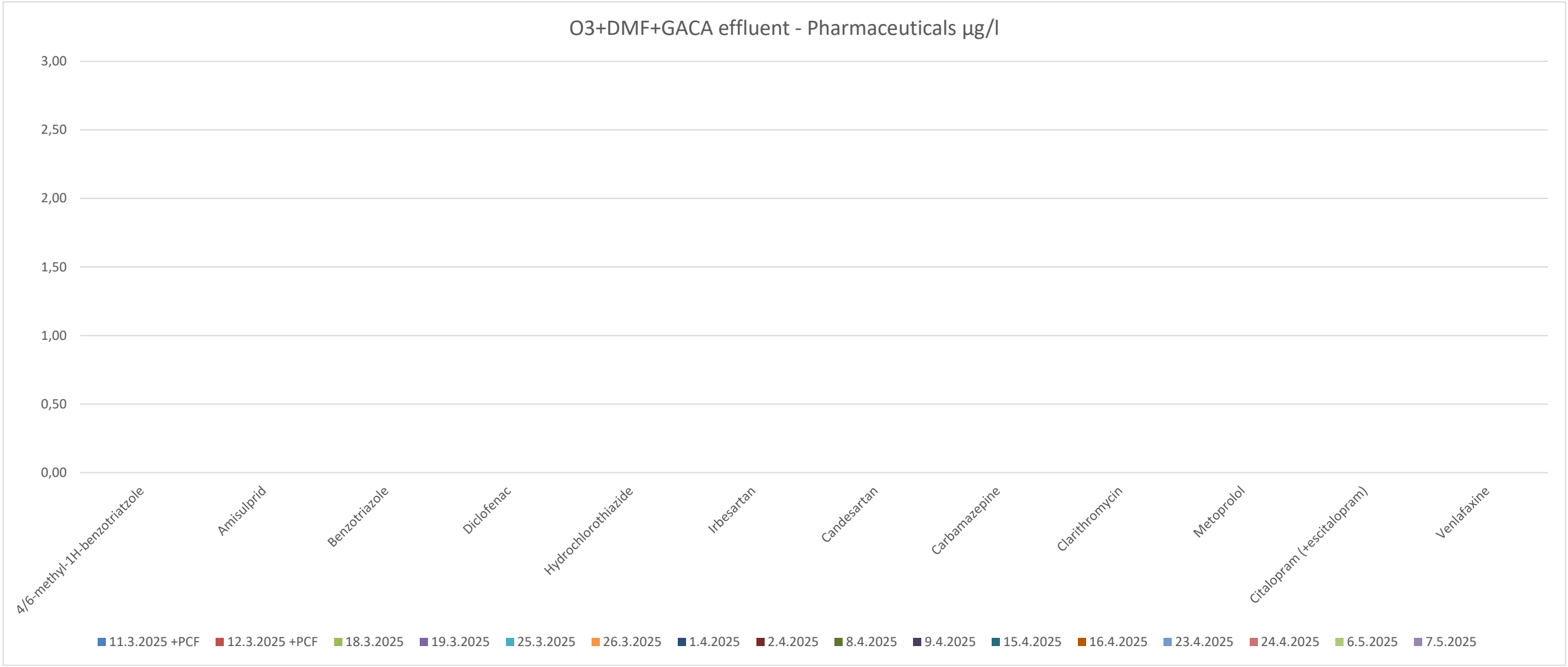
RESULTS - PHARMACEUTICALS



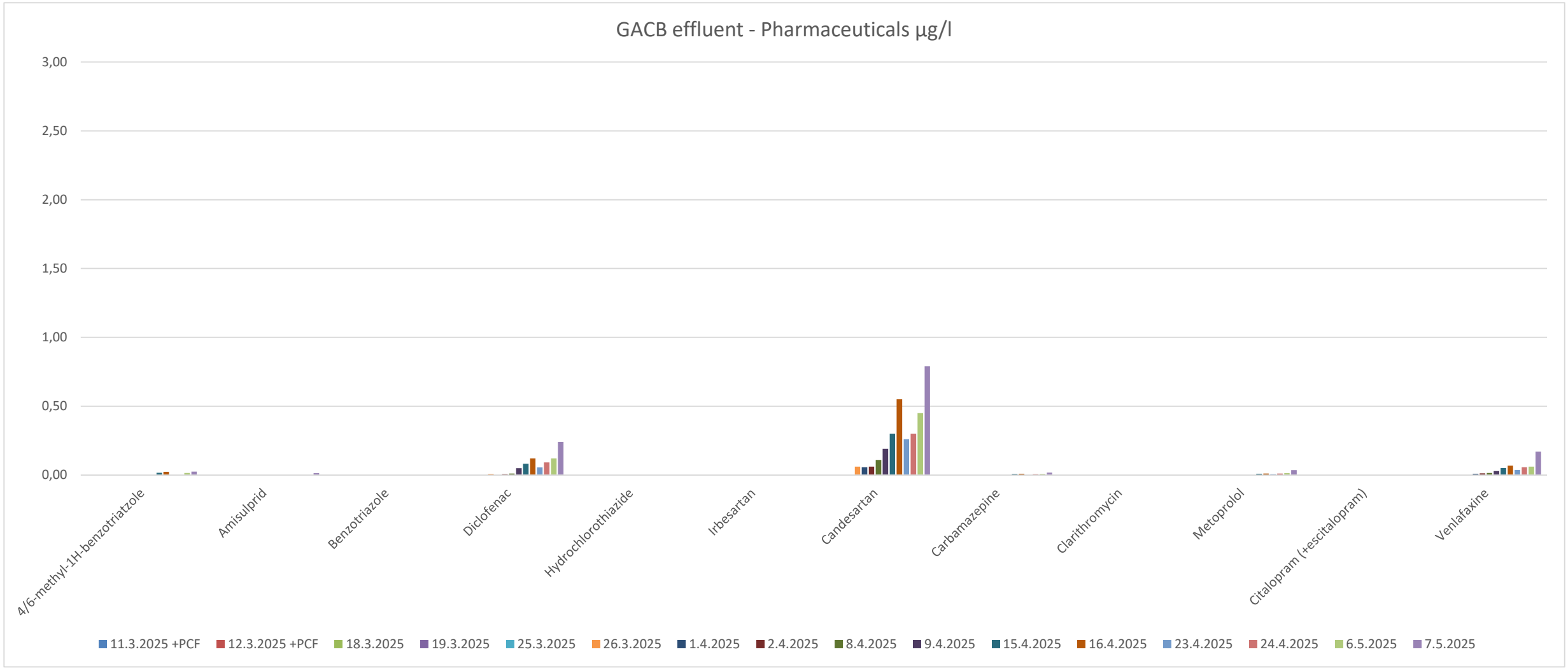
RESULTS - PHARMACEUTICALS



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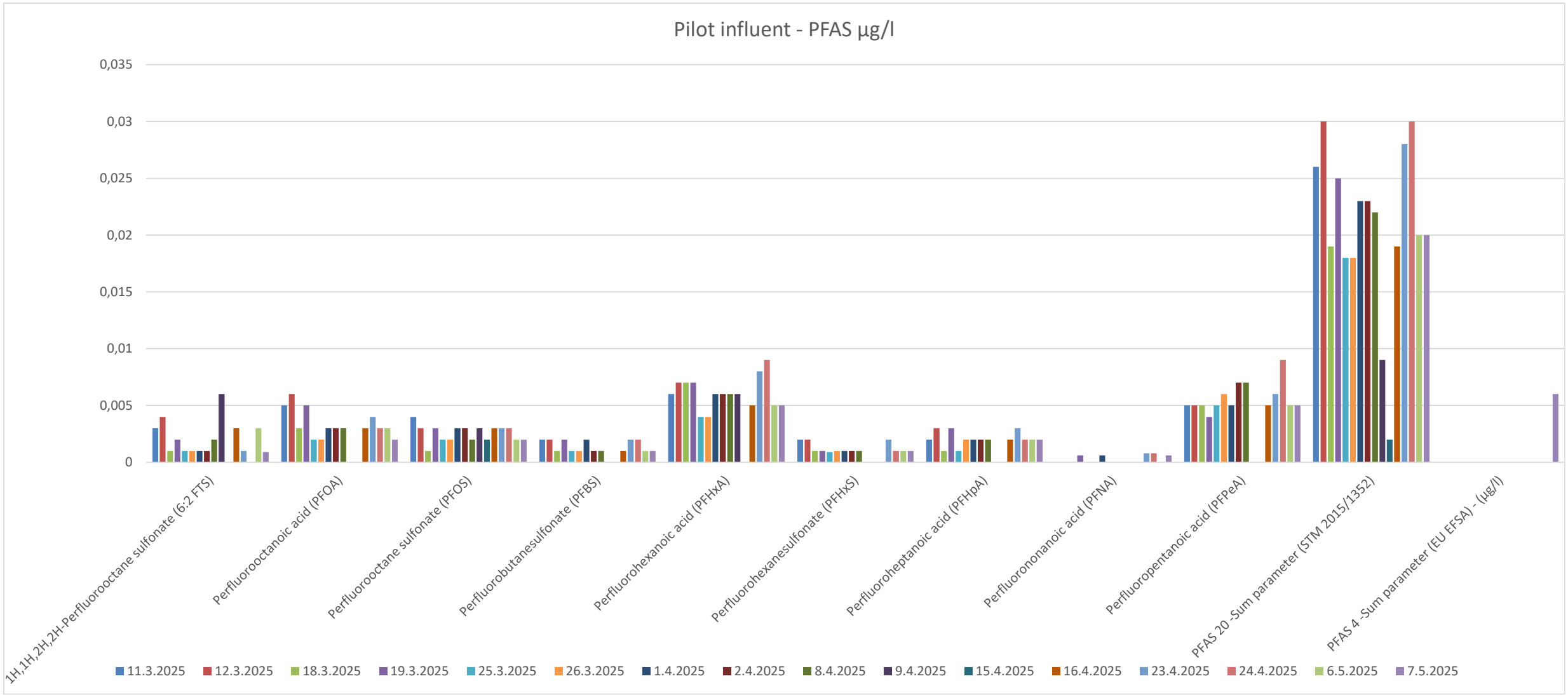


RESULTS - PHARMACEUTICALS



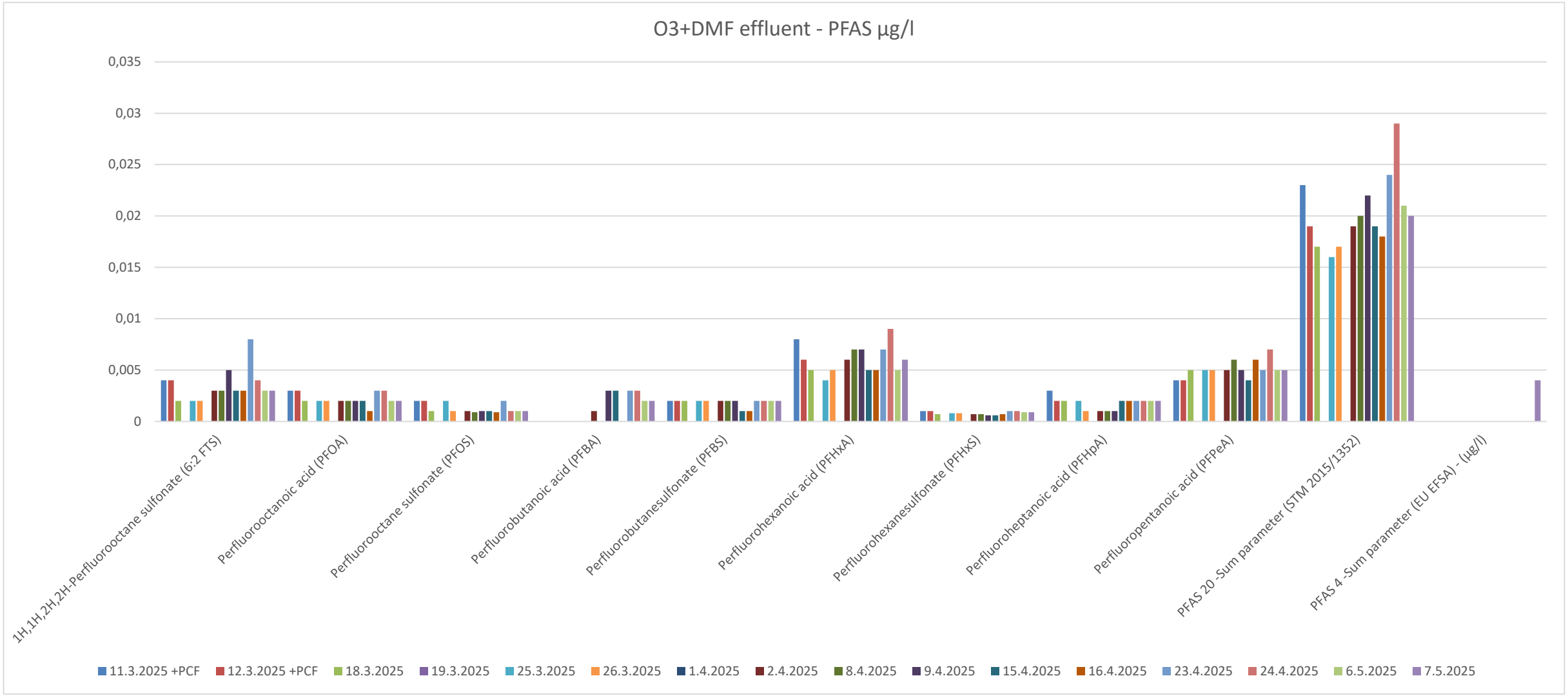
RESULTS – PFAS

Diagram including only combounds which were detected and sum parametres



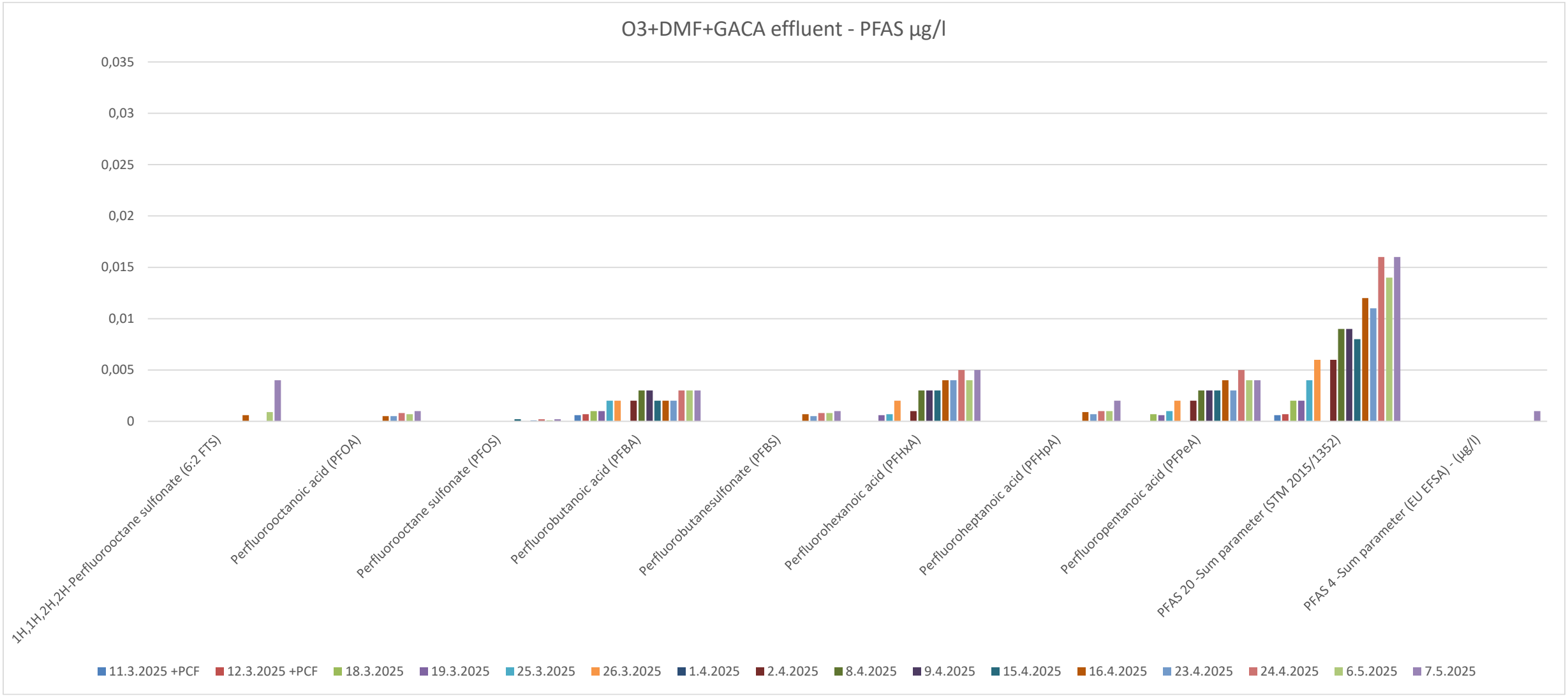
RESULTS – PFAS

Diagram including only combounds which were detected and sum parametres



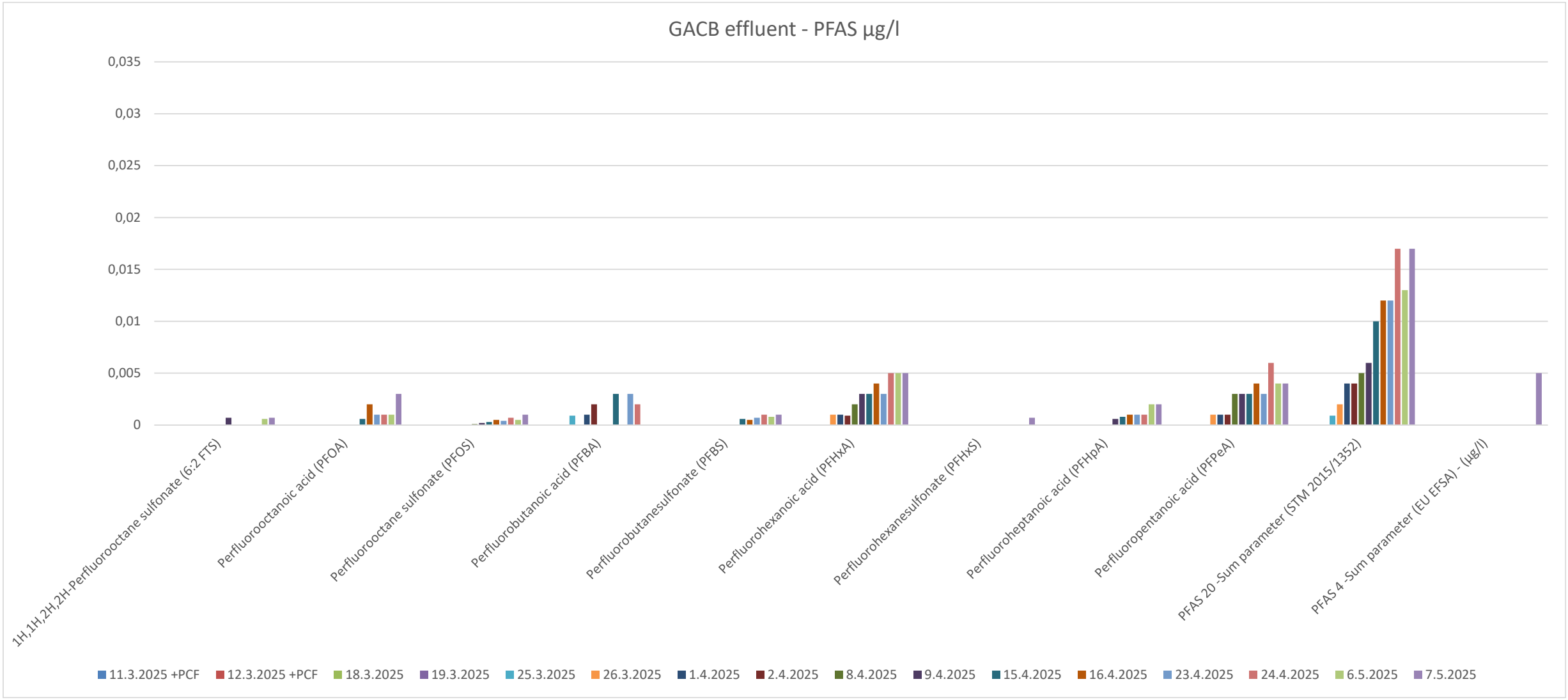
RESULTS – PFAS

Diagram including only combounds which were detected and sum parametres



RESULTS – PFAS

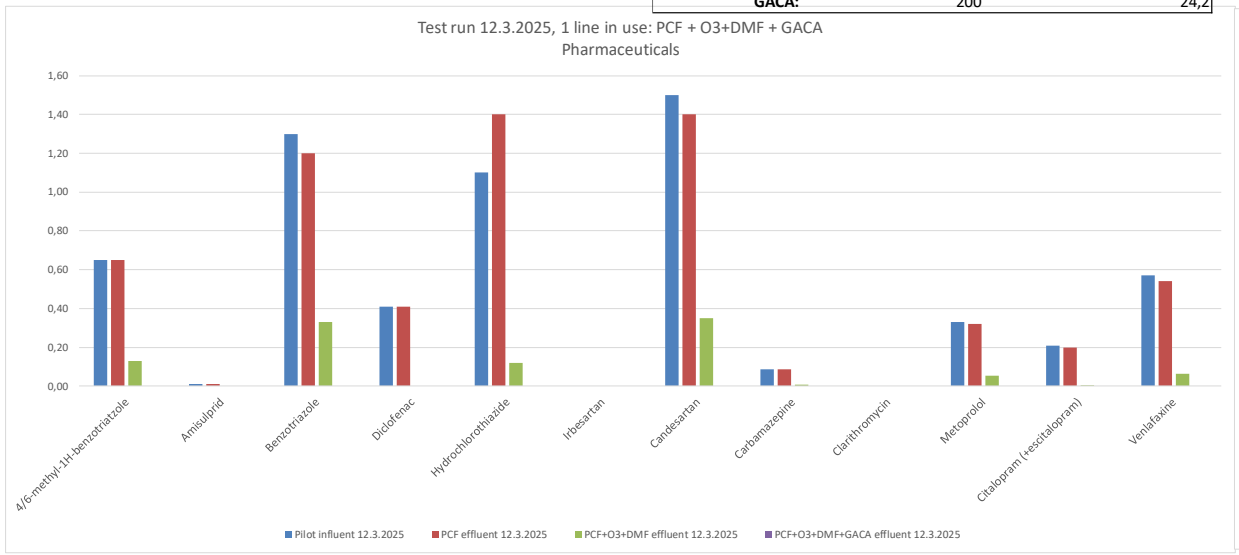
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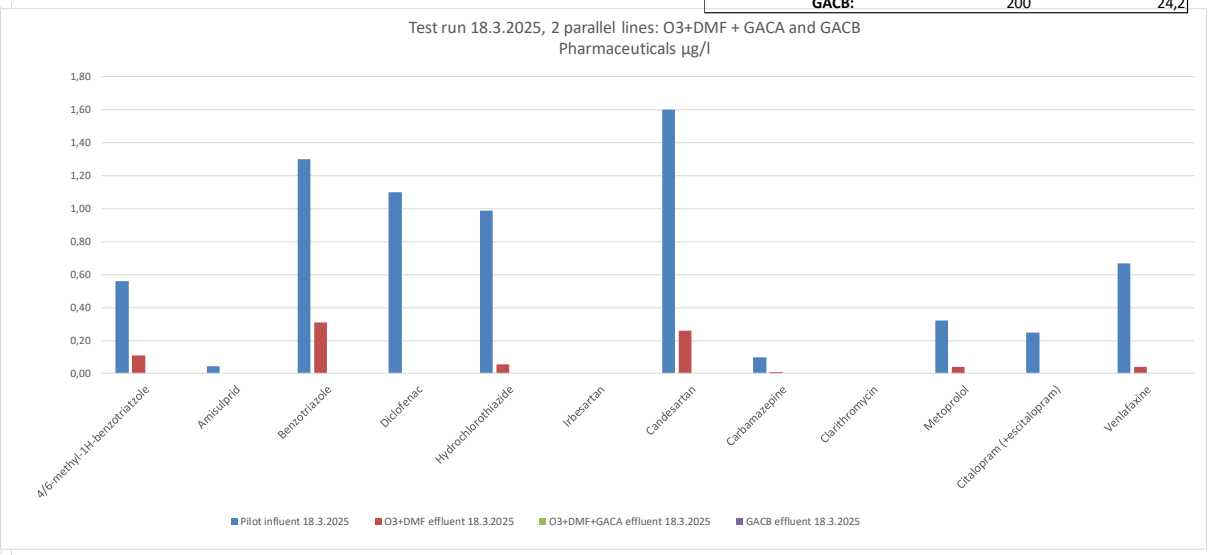


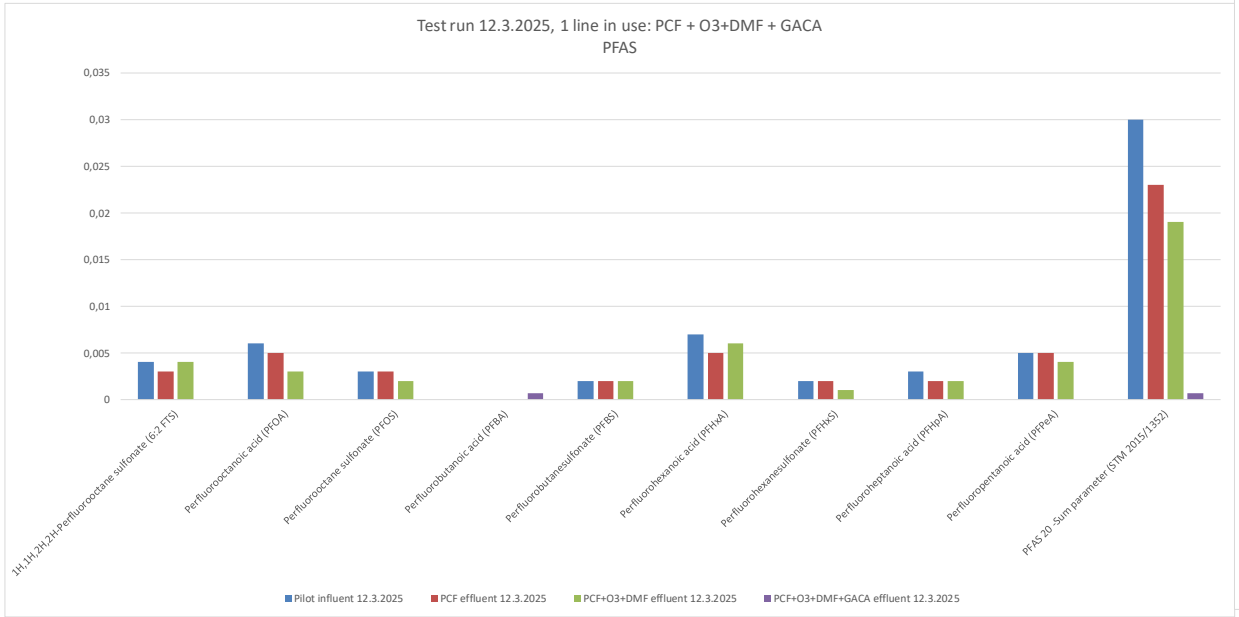
RESULTS

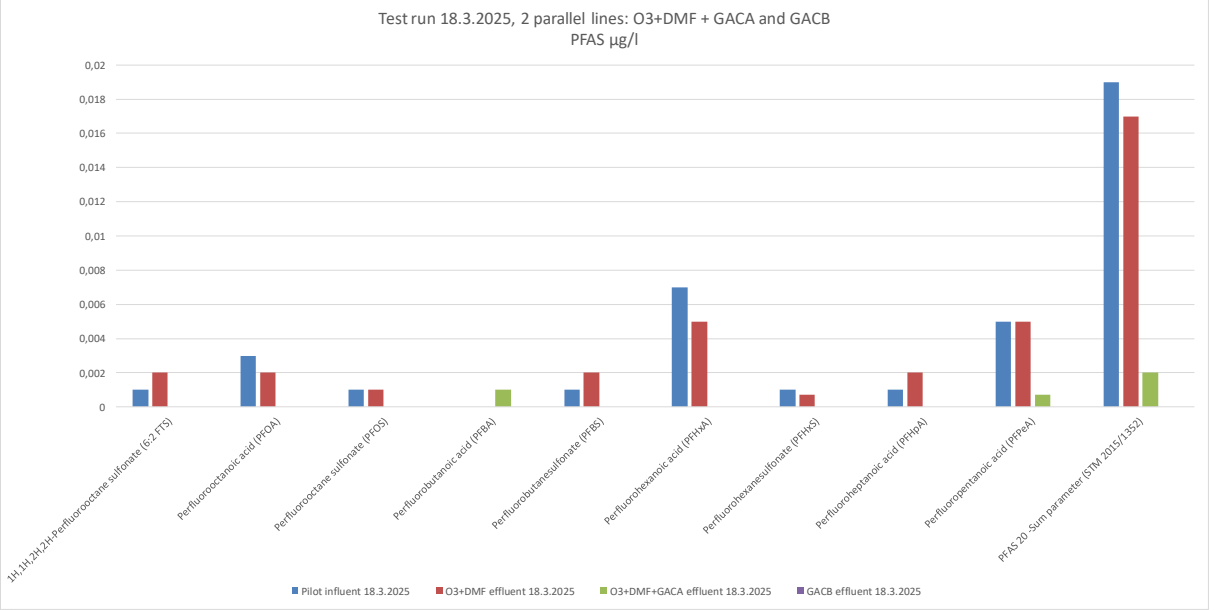
PCF in use	Flow (L/h):	Contact time (min):
O3:	620	4,8
GACA:	200	24,2

	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	200	24,2
GACB:	200	24,2



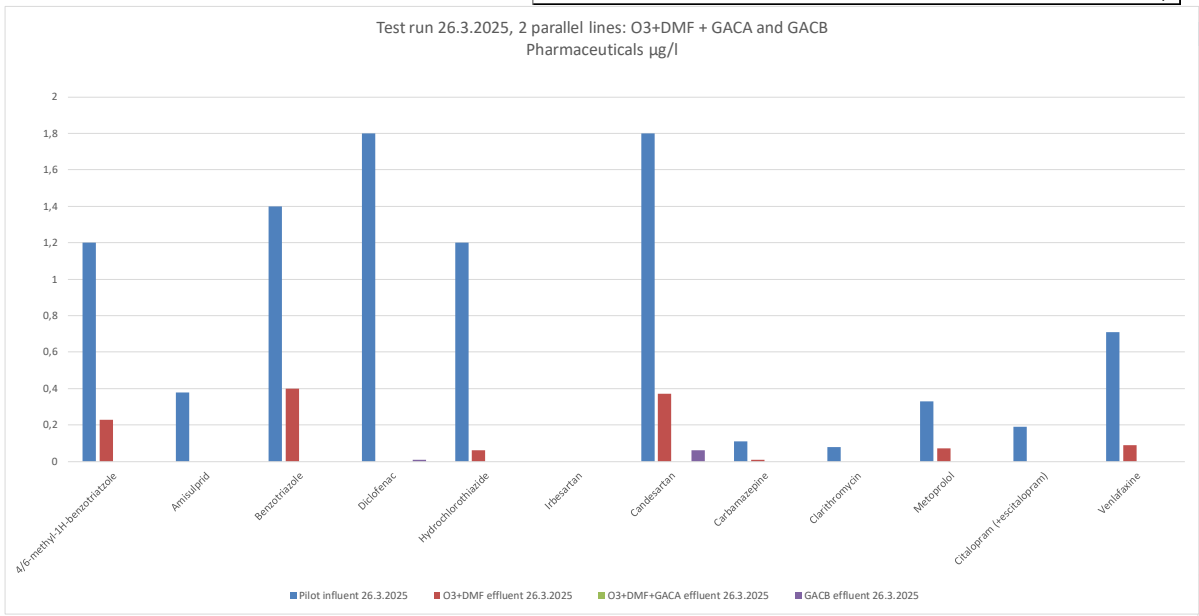


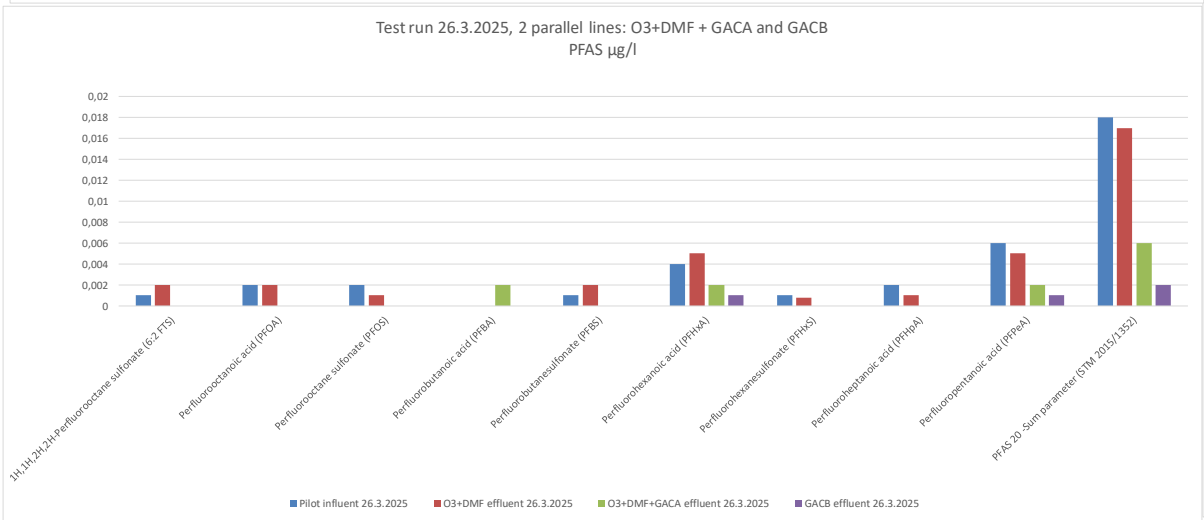




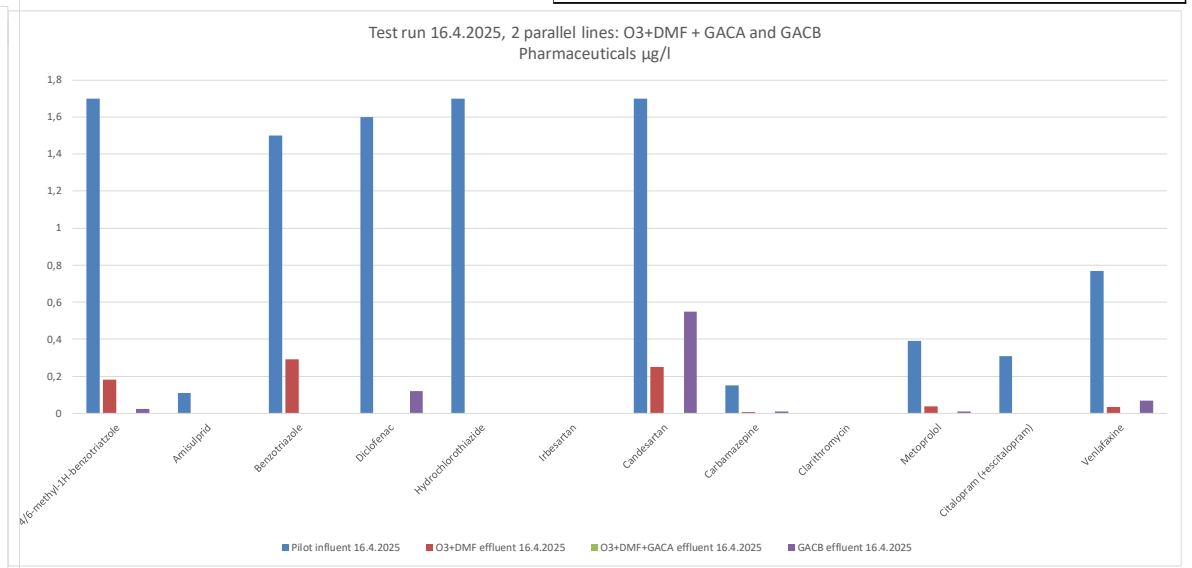
RESULTS

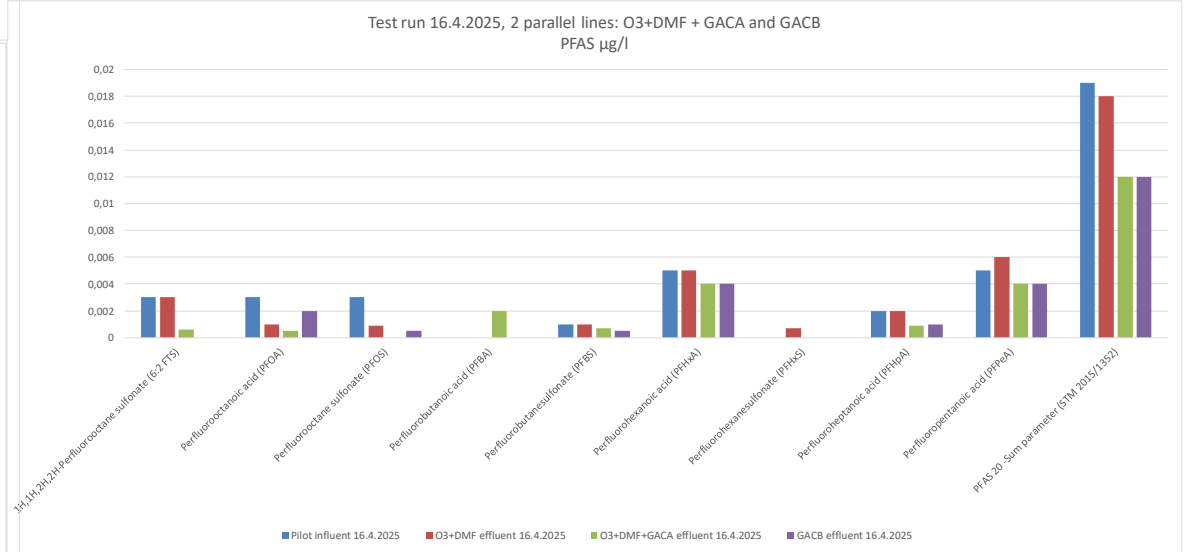
	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	450	10,8
GACB:	450	10,8





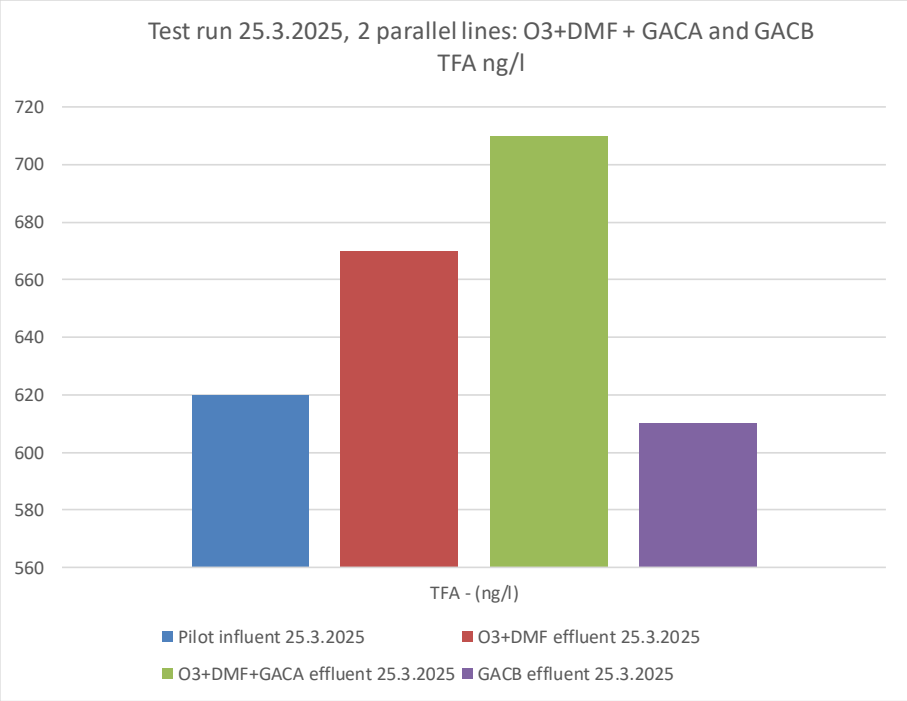
	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	450	10,8
GACB:	450	10,8

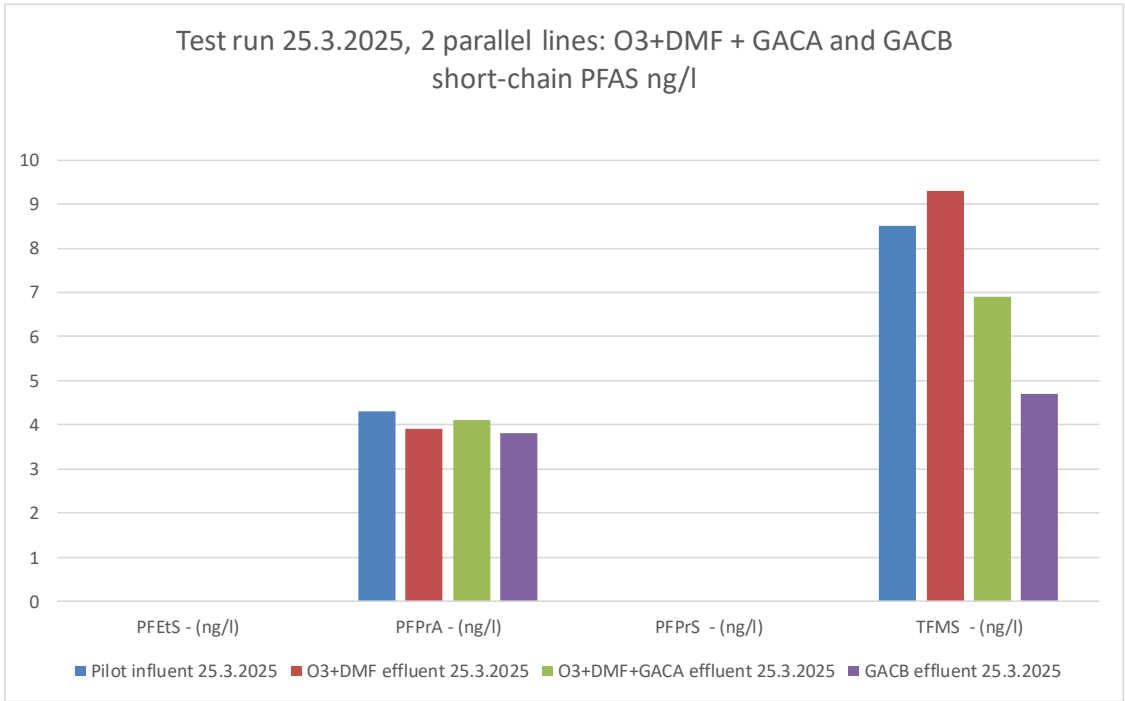




RESULTS

	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	250	19,4
GACB:	250	19,4

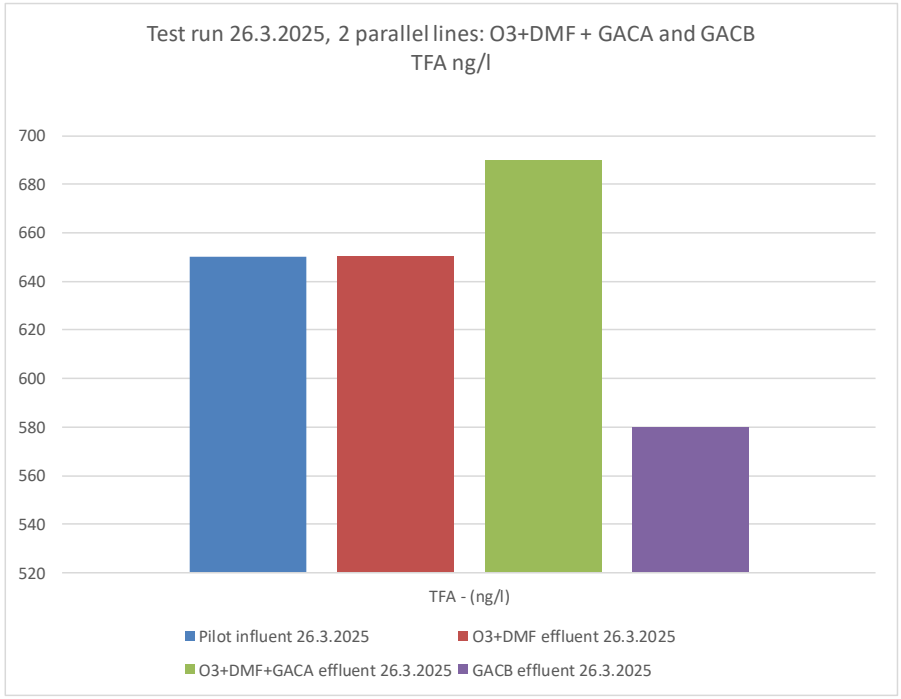


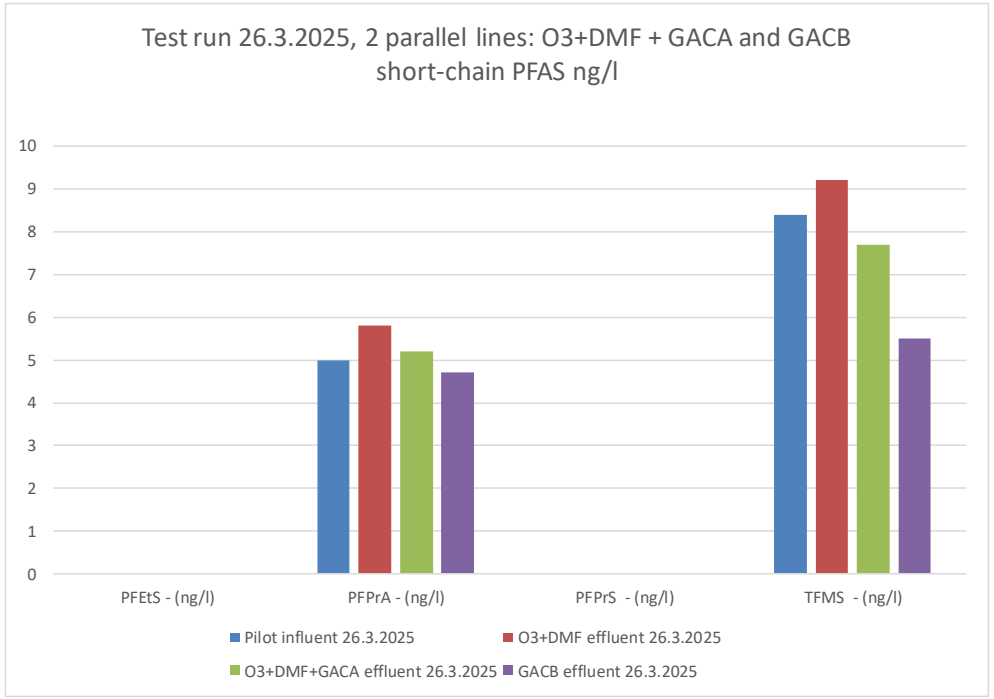


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RESULTS

	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	450	10,8
GACB:	450	10,8

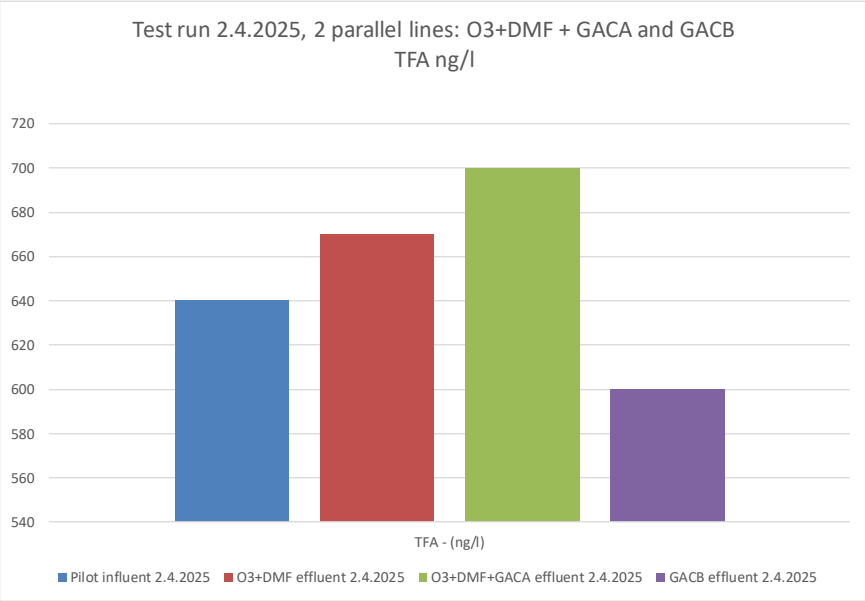


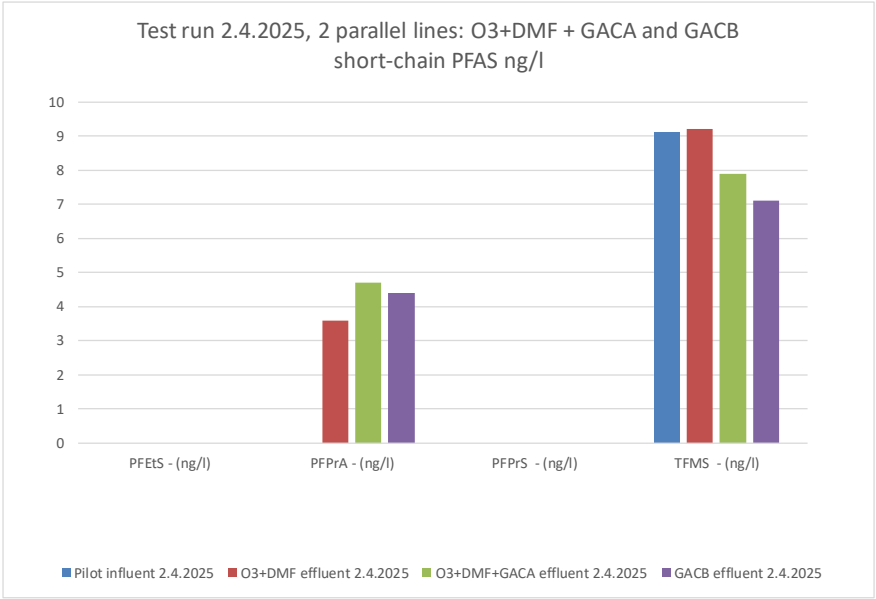


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RESULTS

	Flow (L/h):	Contact time (min):
O3:	600	5
GACA:	150	32,3
GACB:	150	32,3





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FUTURE PLANS

- Test runs will be carried out for about two more months.
- The tests focus mainly on looking at how activated carbon works with different delays.
- A preliminary review of the plant-scale micropollutant removal solution was carried out in 2024.
- The results of the tests at the container treatment plant will be used to design a full-scale solution. Planning work will begin in late 2025.



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