NEDERLAND AQUA
THE FUTURE OF WATER MANAGEMENT

Waterschap De Dommel

IPMV pilots upflow GAK filtratie rwzi Hapert

Joost van den Bulk/ TAUW / 19 maart 2024

croonwolter&dros | TBI

mobilis | TBI

TAUW

Rwb
A Metawater Company

SWECO

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WZA

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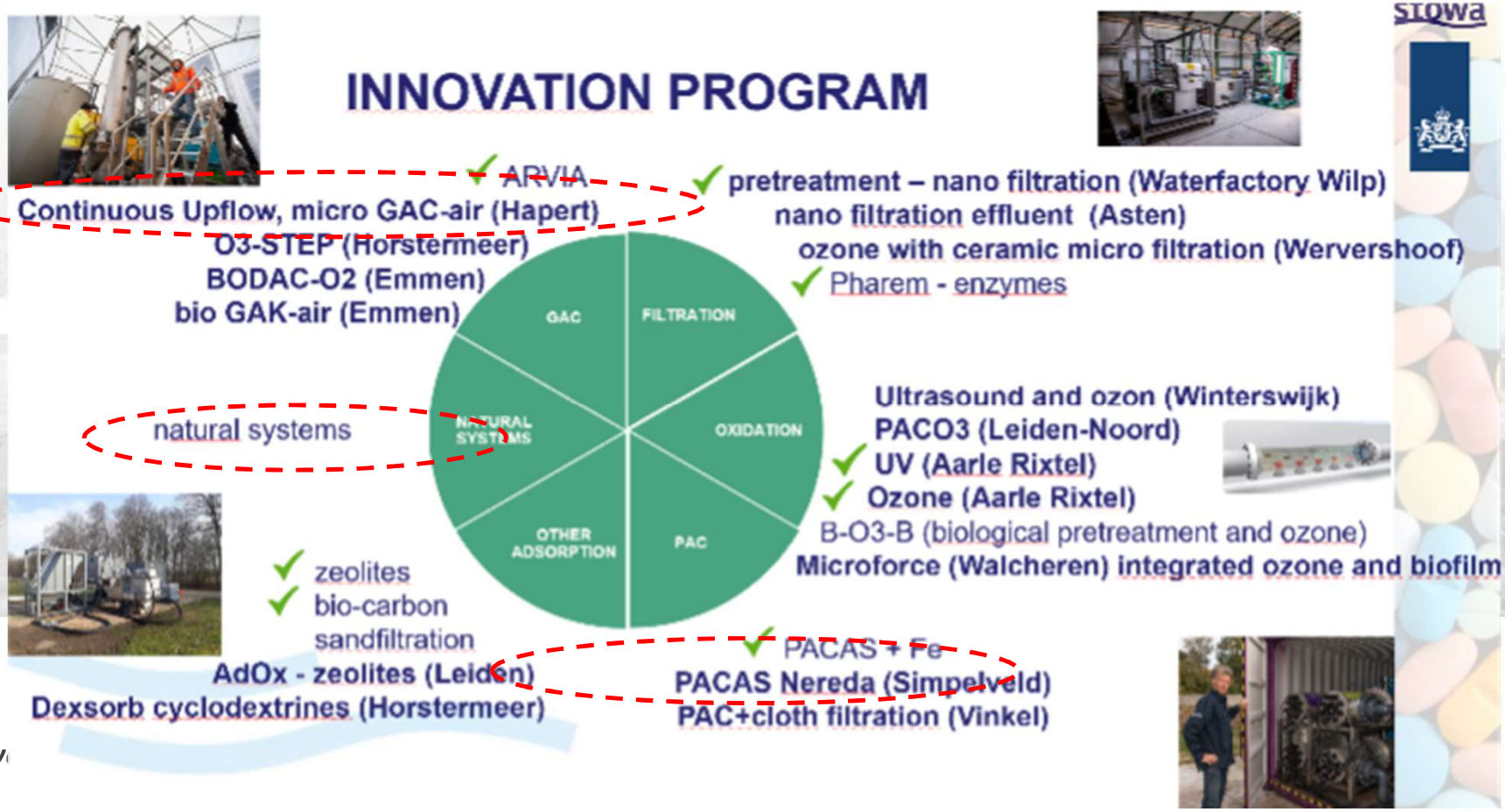
WATER ZUIVERINGEN ALLIANTIE: SAMEN BOUWT HET BETER
Mobilis – Croonwolter&dros – RWB – TAUW - Sweco

Water Zuiveringen Alliantie (WZA)

Innovatie programma micro verontreinigingen STOWA/Ministerie I&W

Evaluatie IPMV door TAUW en SWECO → actualisatie verwijderingsrendementen, CO2 en kosten

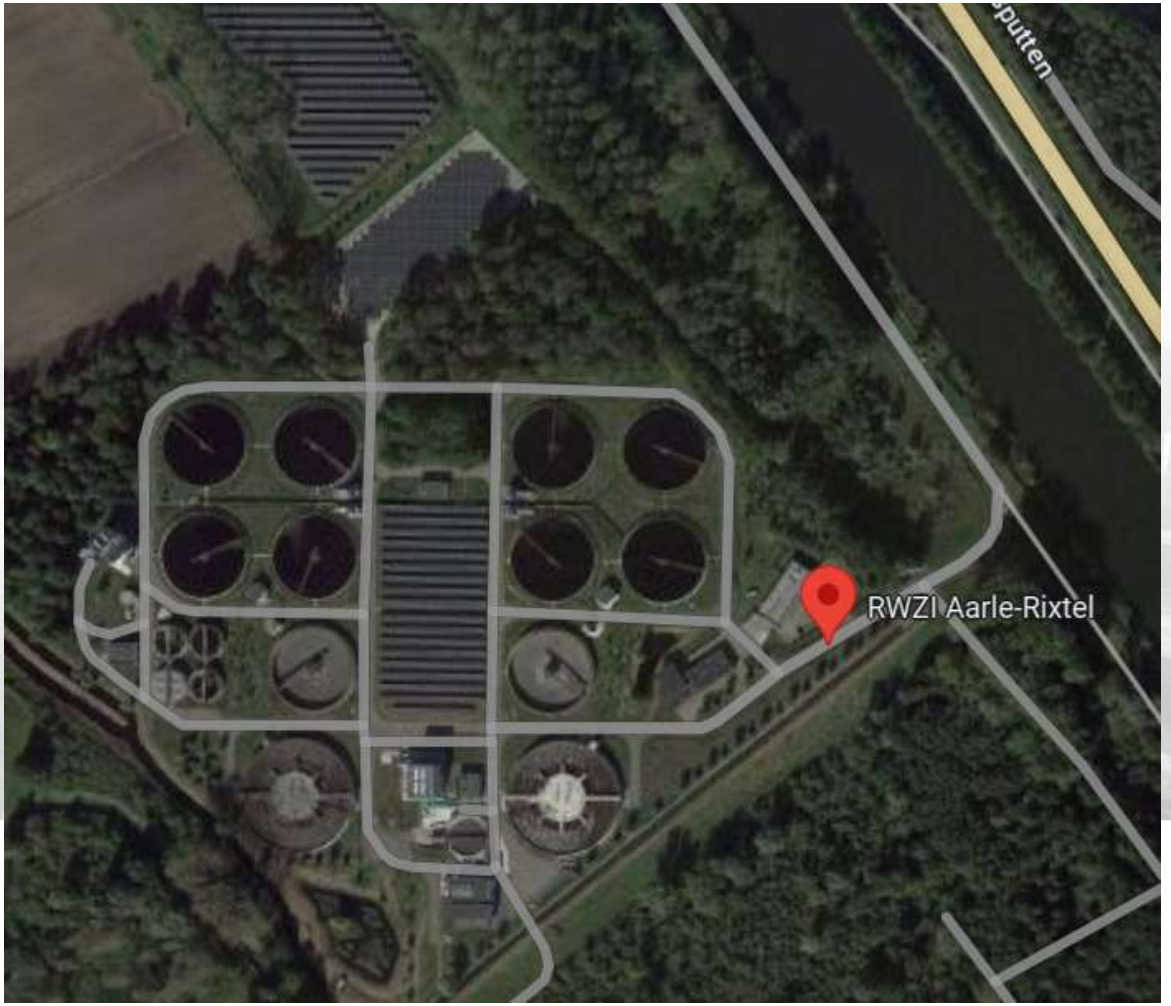


Nabehandelingsinstallatie rwzi Aarle Rixtel

Diverse studies voor waterschappen waaronder nabehandelingsinstallatie rwzi Aarle Rixtel, Aa en Maas

300.000 i.e.

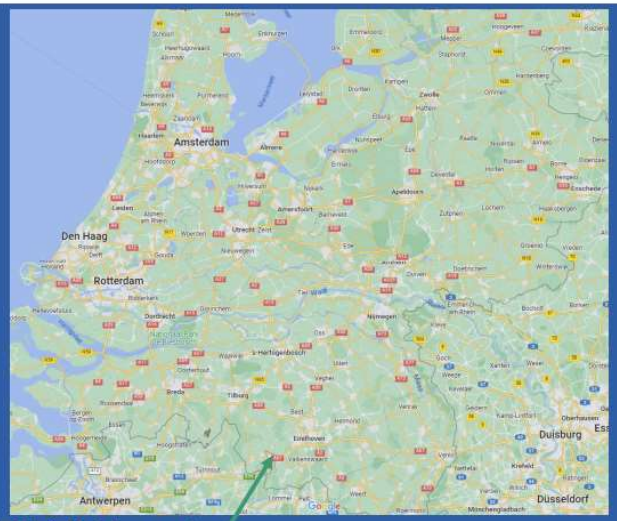
Gecombineerde verwijdering N, P en micro verontreinigingen



Water Zuiveringen Alliantie (WZA)

2 upflow GAK pilots op rwzi Hapert

Where were the pilot installations tested?



RWZI Hapert:

64.373 p.e.

12.085 m³/day (average)

Effluent treated in waterharmonica

Revitalized and released on "Grote Beerze"

Top 10 regional Hotspotanalysis

Aa en Maas	AARLE RIXTEL	8,8%
De Dommel	EINDHOVEN	25,8%
De Dommel	TILBURG-NOORD	13,2%
Aa en Maas	LAND VAN CUIJK (HAPS)	5,4%
Aa en Maas	OIJEN	4,1%
De Dommel	HAPERT	3,1%
Brabantse Delta	RIJEN	1,2%
Limburg	HOENSBROEK	3,7%
Aa en Maas	DINTHER	2,9%
De Dommel	HILVARENBEEK /BIEST-HOUTAKKER	1,9%

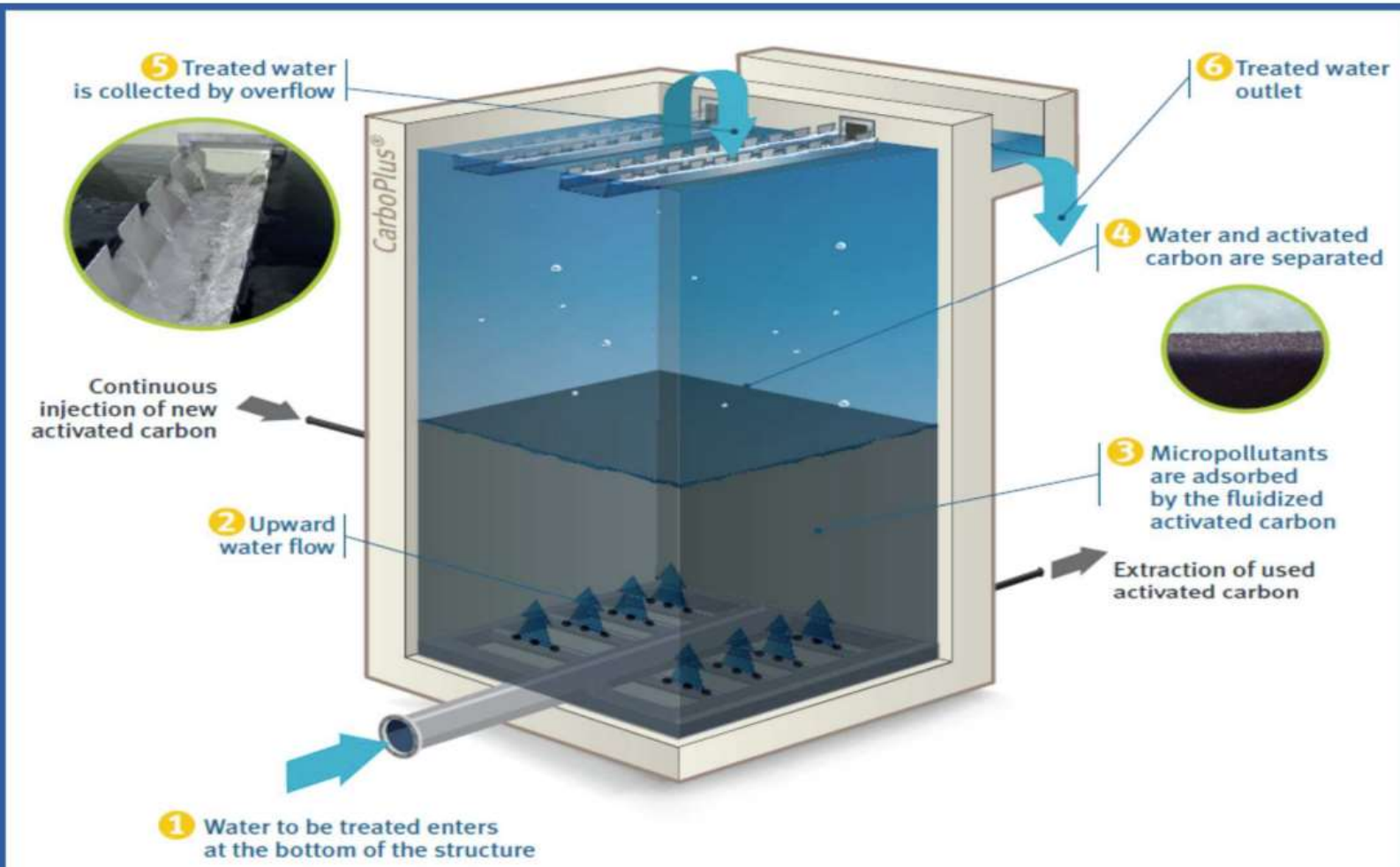
Location pilots

Water Zuiveringen Alliantie (WZA)

Water Zuiveringen Alliantie (WZA)

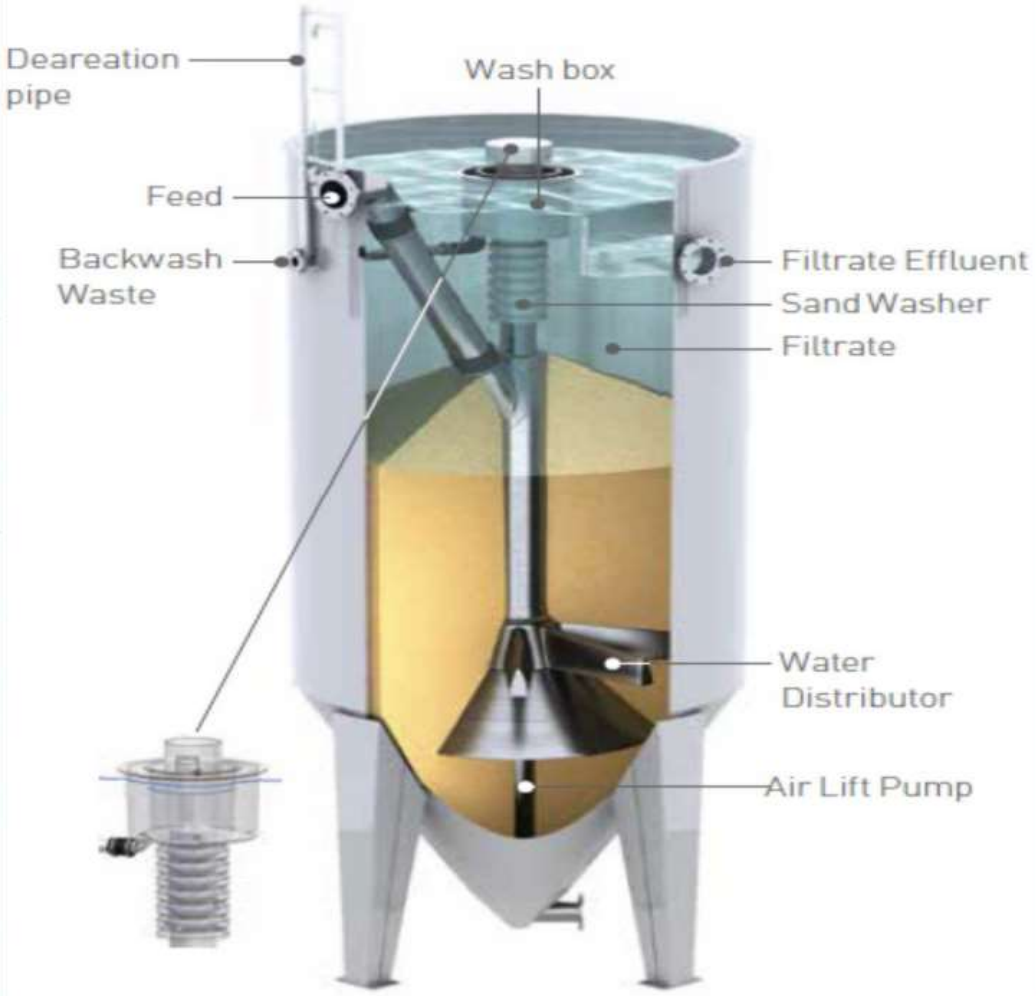
Which technologies?-1 Carboplus

Carboplus
by Stereau

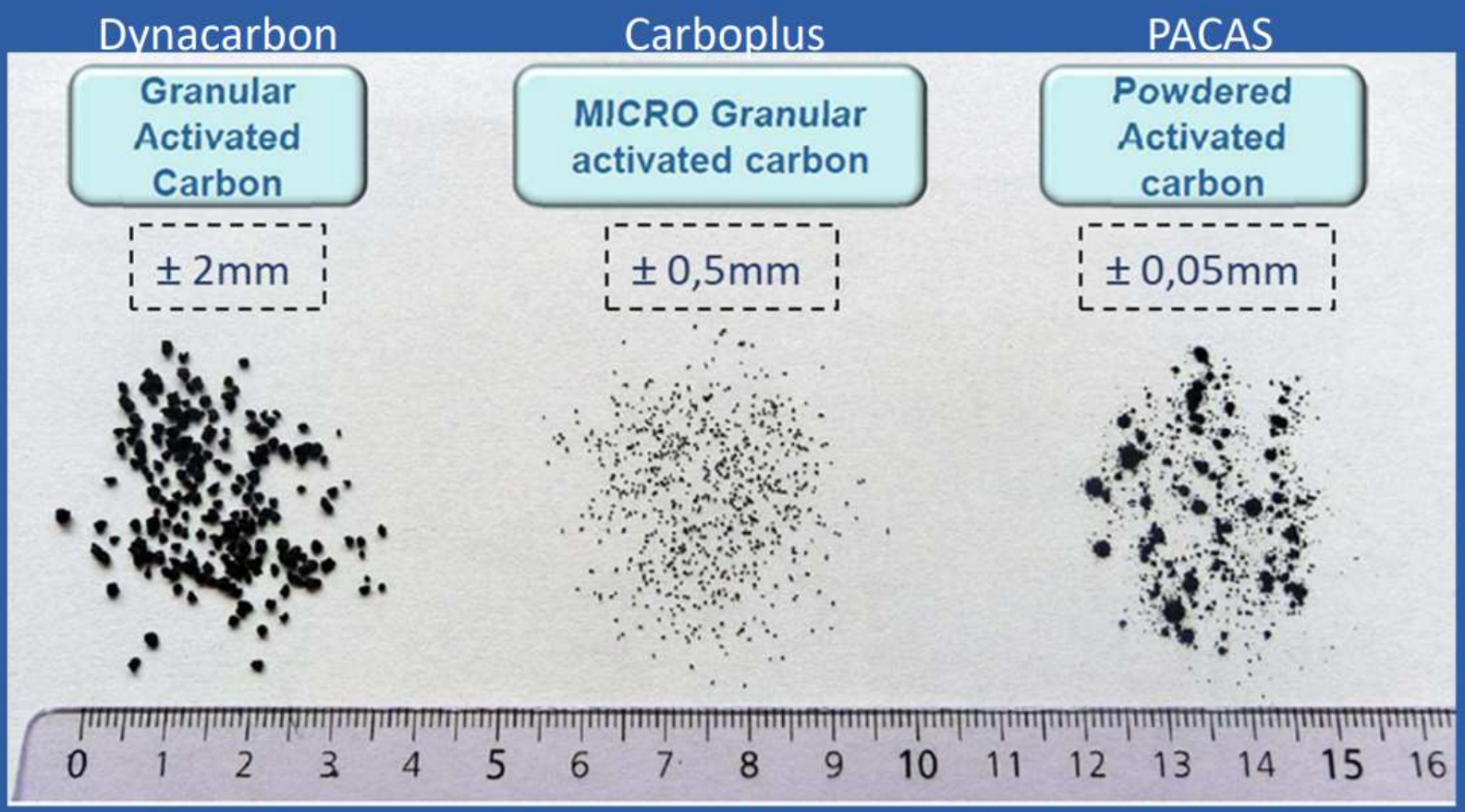


Which technologies? – 2 Dynacarbon

Dynacarbon by Nordicwater



Which type of activated carbon?



Both pilots were operated using Cyclecarb (a reactivated carbon) by Chemviron

Carboplus - pilotinstallation

What does the pilot look like?

Pilot:

Dosage of coal - manually

Extraction of coal - manually

Flushing – manually

Full scale:

Dosage of coal - automatically

Extraction of coal – automatically

Flushing - automatically

Carboplus

Used Carbon: Cyclecarb 305, Chemviron

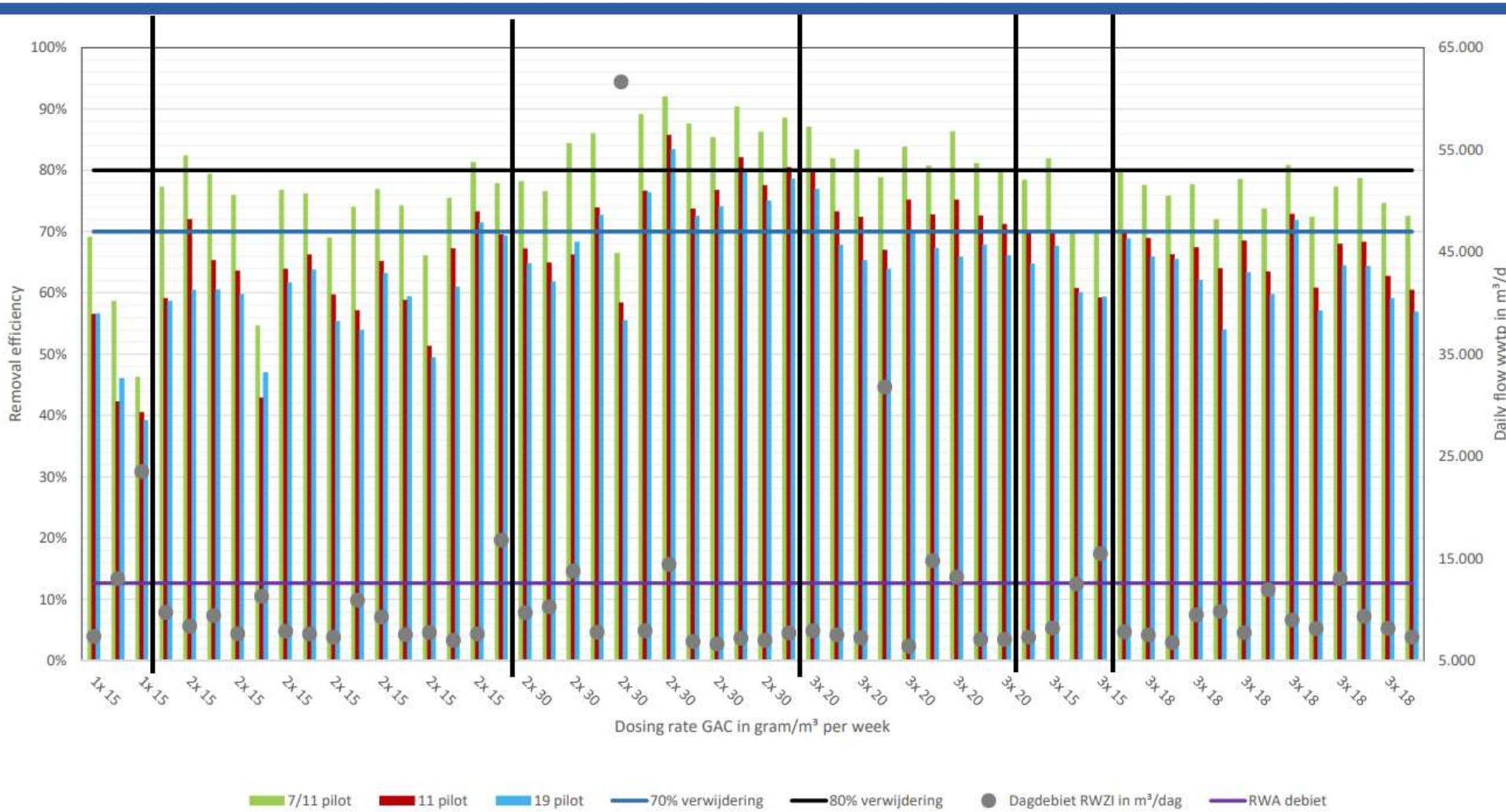
Bed height at rest: ~1,50m => Bed height in expansion: ~ 2,10m

Feed flow rate: ~ 0,266m³/h => Total treated volume: m³

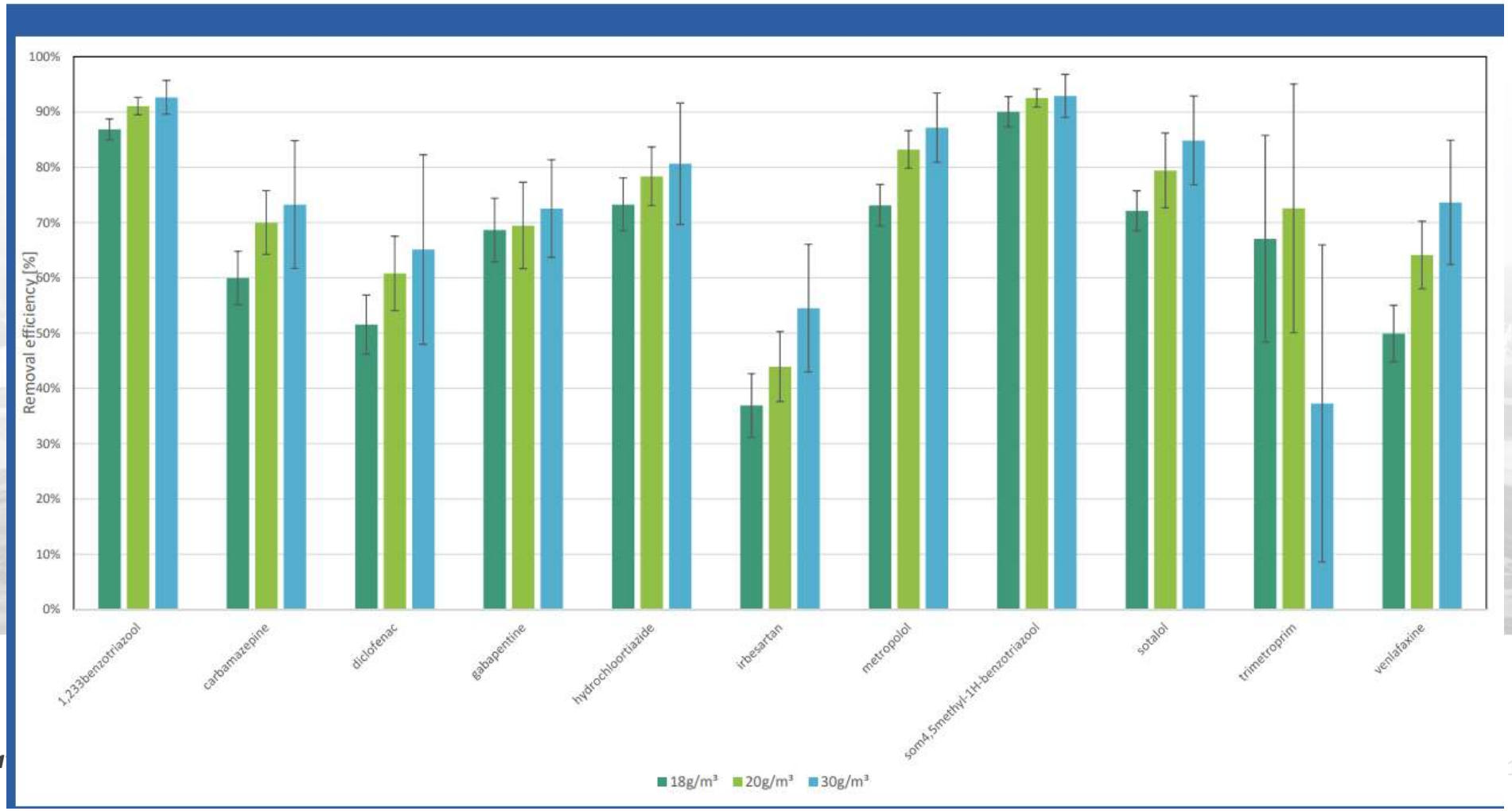
Tested feeding rates: 15, 18, 20, 30 g/m³

	Nov `20	Dec `20	Jan `21	Feb `21	Mar `21	Apr `21	May `21	Jun `21	Jul `21	Aug `21	Sep `21	Oct `21	Nov `21	Dec `21	Jan `22	Feb `22	Mar `22
dosing rate [g/m³]	Start-up		15						30			20	15	18			
Addition of coal [times per week]			1			2								3			
Addition pre-treatment	Without Sobye-filter								With Sobye-filter								

Carboplus


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Removal efficiency
65.000
55.000
45.000
35.000
25.000
15.000
5.000
Daily flow wwtp in m³/d
1x 15
1x 15
2x 15
2x 15
2x 15
2x 15
2x 15
2x 15
2x 15
2x 30
2x 30
2x 30
2x 30
2x 30
2x 30
3x 20
3x 20
3x 20
3x 20
3x 20
3x 15
3x 15
3x 18
3x 18
3x 18
3x 18
3x 18
3x 18
Dosing rate GAC in gram/m³ per week
7/11 pilot
11 pilot
19 pilot
70% verwijdering
80% verwijdering
Dagdebiet RWZI in m³/dag
RWA debiet

Carboplus


Removal efficiency [%]
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1,233benzotriazool
carbamazepine
diclofenac
gabapentine
hydrochloortiazide
irbesartan
metropolol
som4,5methyl-1H-benzotriazool
sotalol
trimetroprim
venlafaxine
18g/m³
20g/m³
30g/m³

Dynacarbon - pilotinstallation

What does the pilot look like?

Pre-treatment
effluent wwtp
Sobye-filter
=>algae removal

Data logged and available online:

- Flow
- Treated bedvolumes
- Filter pressure
- EBCT

720kg GAC inserted

Automated liquid and air flush

Influent wwtp in, effluent pilot out

Dynacarbon

Used Carbon: Cyclecarb 401, Chemviron

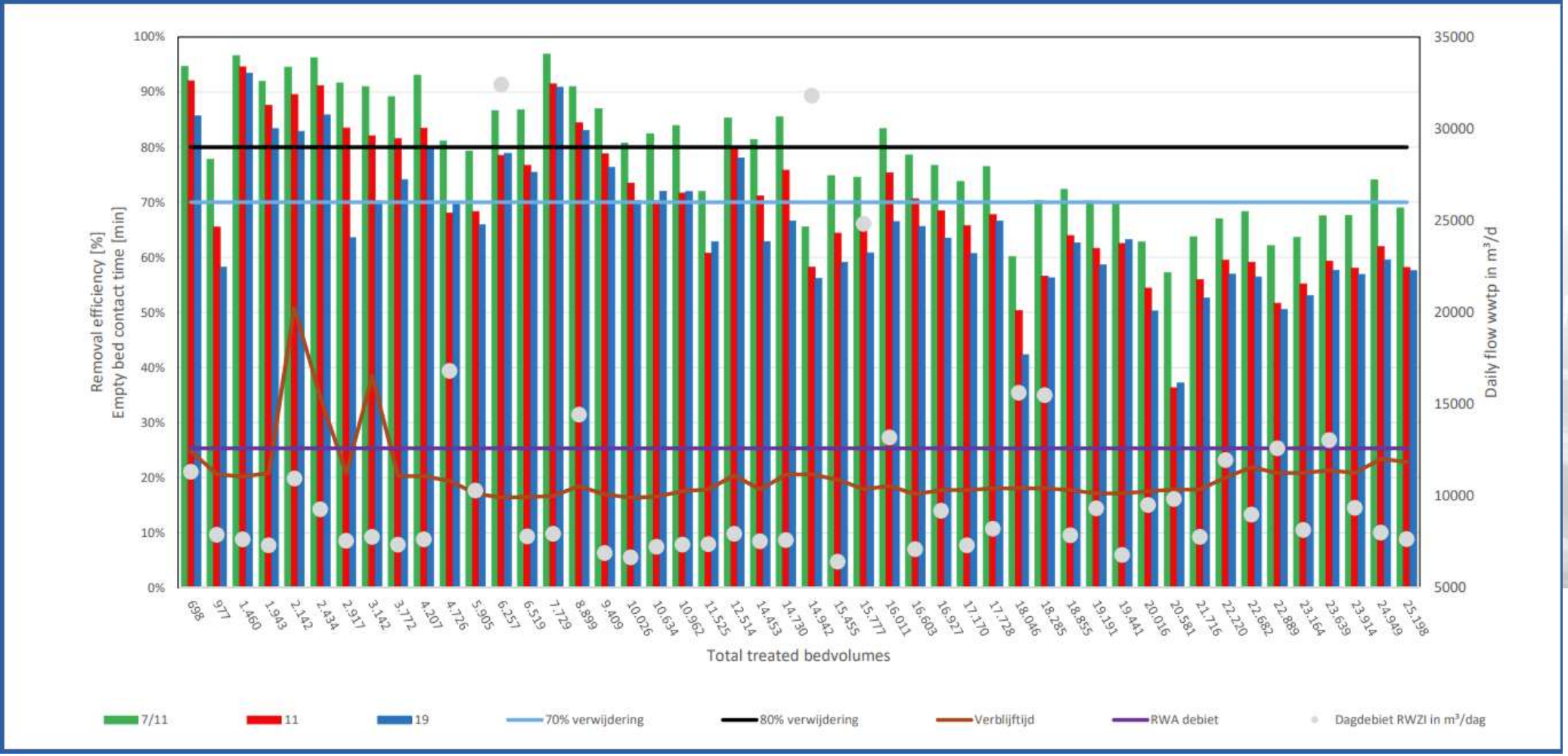
Start november 2020 using 720 kg GAC

Stopped march after 4293m³

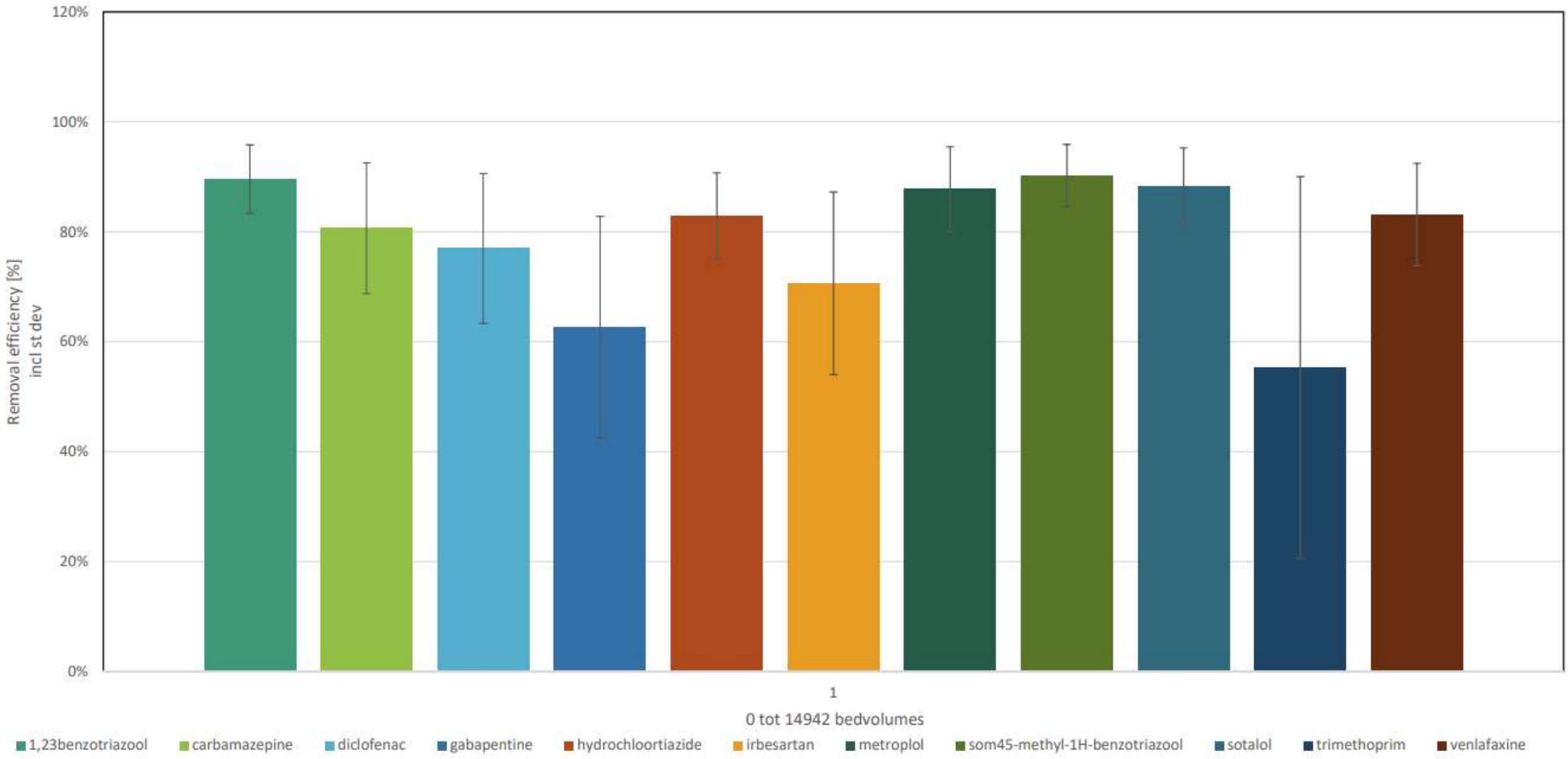
restart 1-4-2021 using 720kg GAC

	Nov `20	Dec `20	Jan `21	Feb `21	Mar `21	Apr `21	May `21	Jun `21	Jul `21	Aug `21	Sep `21	Oct `21	Nov `21	Dec `21	Jan `22	Feb `22	Mar `22
ebct[min]	first start-up								30			20			15	18			
EBCT [min]						28 (with fluctuations)			18							21	23
Addition pre-treatment	Without Sobye-filter								With Sobye-filter								

Dynacarbon


Removal efficiency [%]
Empty bed contact time [min]
Daily flow wwtp in m³/d
Total treated bedvolumes
7/11
11
19
70% verwijdering
80% verwijdering
Verblijftijd
RWA debiet
Dagdebiet RWZI in m³/dag

Dynacarbon


120%
100%
80%
60%
40%
20%
0%
Removal efficiency [%]
incl st dev
1
0 tot 14942 bedvolumes
1,23benzotriazool
carbamazepine
diclofenac
gabapentine
hydrochloortiazide
irbesartan
metroplol
som45-methyl-1H-benzotriazool
sotalol
trimethoprim
venlafaxine

Summary Performances

	UNIT	PACAS	Ozone + Sand Filtration	Carboplus	Dynacarbon
CO_2-footprint [1]	g CO_2/m^3	122	128	96 - 173	110 - 187
Costs [1]	€/m^3	0,05	0,17	0,15	0,21
Removal Efficiency Dutch guide substances[2]	%	70-75%	80-85%	80 – 85%	80 – 85%

[1] 1 Per treated m3 wastewater: peak dry weather flow must be treated. ***Please note: standardized cost and CO2 levels for 2018****; recalibration of all CO2- and cost levels will take place during the evaluation of the Innovation Program in 2024*

[2] Overall Removal Efficiency of effluent wwtp to influent wwtp (including bypass post treatment) for 7 of 11 guide substances: benzotriazool, carbamazepine, diclofenac, irbesartan, gabapentine, metropolol, hydrochloorthiazide, mixture of 4- en 5-methylbenzotriazool, sotalol, trimethoprim en venlaflaxine in every 24h or 48h flow or time proportional sample. The sampling has to take the hydraulic retention time of the wwtp into account.

Consequences stricter removal efficiencies Proposal EU Urban Wastewater Treatment Directive (80% in EU in stead of 70% in NL and different guide substances):

- PACAS will have a footprint of 160 g CO2/m3 and a cost level of € 0,08/m^3; no changes for ozone
- Carboplus will have a footprint of 96 - 173 g CO2/m3 and a cost level of € 0,15 €/m^3
- Dynacarbon will have a footprint of 110 - 187 g CO2/m3 and a cost level of € 0,21/m^3

Conclusions

- Carboplus and Dynacarbon remove >85% of Dutch micropollutants (best 7 out of 11)
- Carboplus and Dynacarbon both reduce ecotoxcity with >50%
- Carboplus and Dynacarbon both remove around 20-40% of PFAS
- Carboplus and Dynacarbon remove >85% of European micropollutants
- The Carboplus pilot needed a relatively high dosing rate of 30g/m³
- The Dynacarbon pilot reached a total of 15.000 treated bedvolumes only
- The Dynacarbon pilot needed a pre-treatment to reach stable operation

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