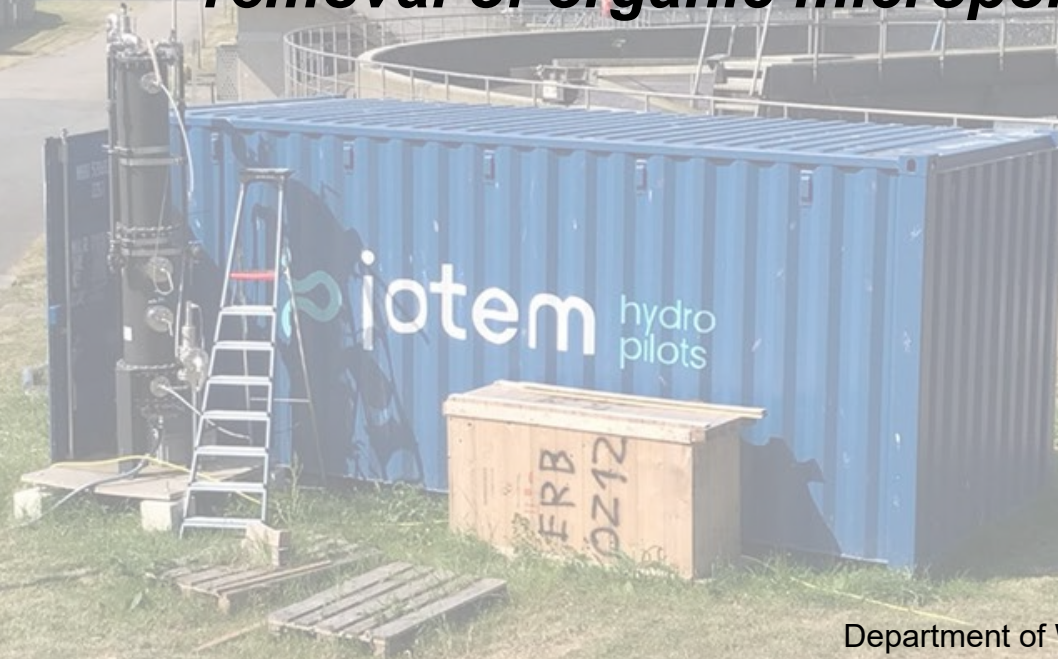


AdOx

A next-generation adsorption-oxidation process for the removal of organic micropollutants from municipal wastewater effluent



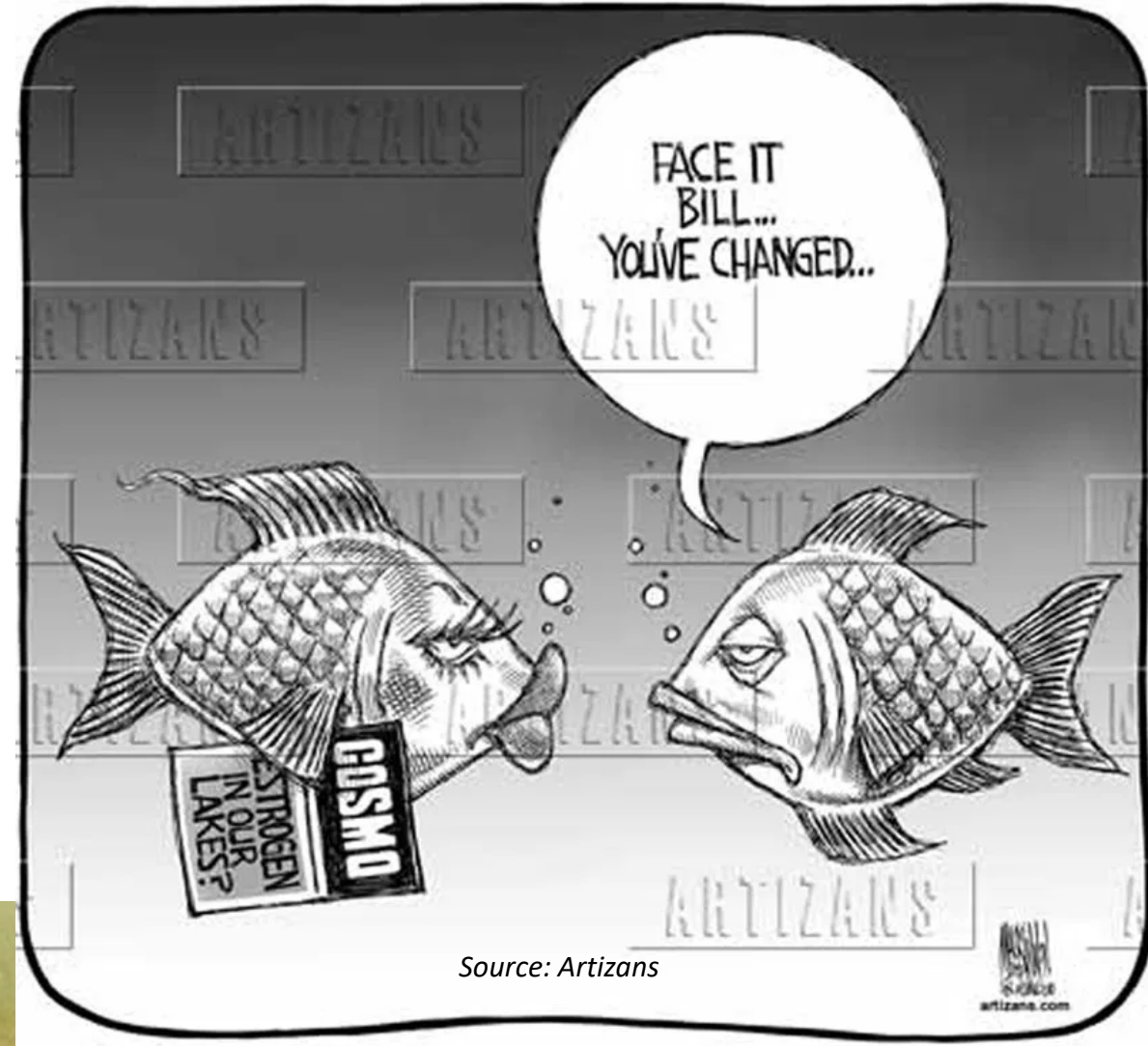
Nessia Fausta

TU Delft | Delft University of Technology
Department of Water Management, sanitary engineering section
Faculty of Civil Engineering & Geosciences

Organic Micropollutants (OMPs): a current driver in wastewater industries



Wastewater Treatment Plants
(WWTPs)



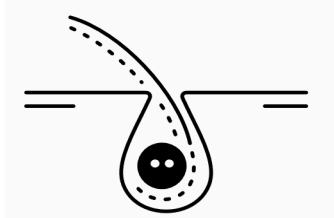
Source: Artizans


Idea behind AdOx: integrated adsorption – oxidation


AdOx



Source: The Noun Project

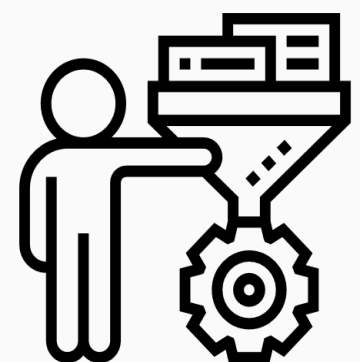

Adsorption
with high-silica
zeolite granules


Source: Max Fu


Source: IndiaMart

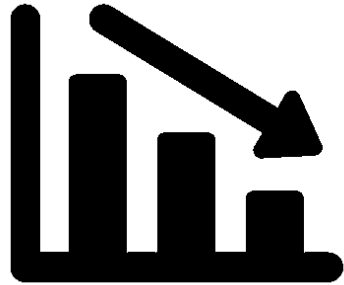

In-situ
regeneration
with ozone gas


Source: The Noun Project

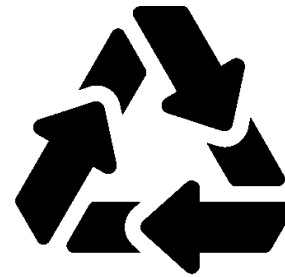

Continuous cycle

Source: The Noun Project

AdOx's objectives: aligned with STOWA guidelines & the needs of WWTPs



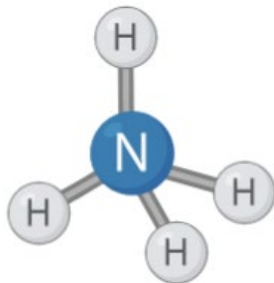
Min. 70% removal of OMPs
Min. 7 from 11 guide substances



Sustainable
(low CO₂ footprint)



Price competitive,
possibilities for
cost optimization



Polishing of ammonium (simultaneously)

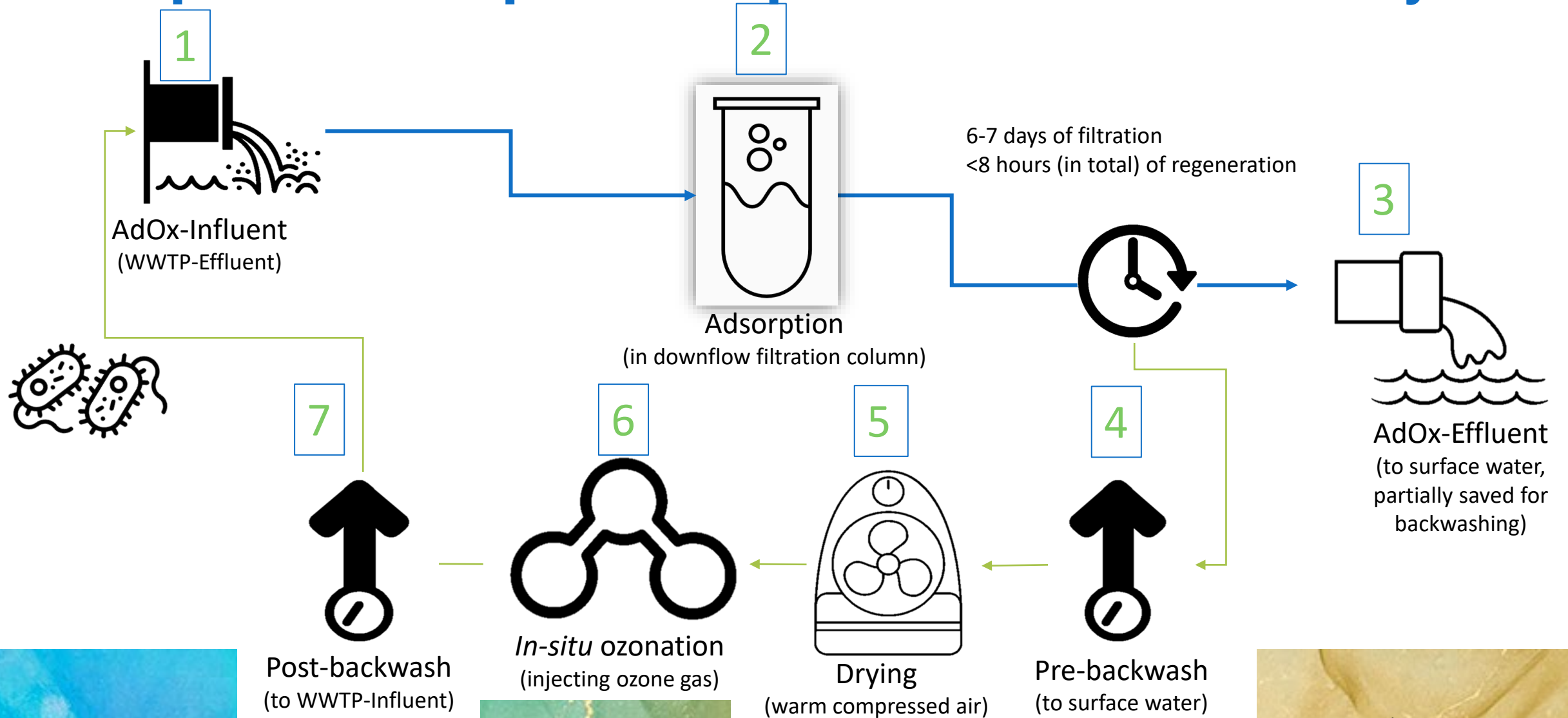


No bromate

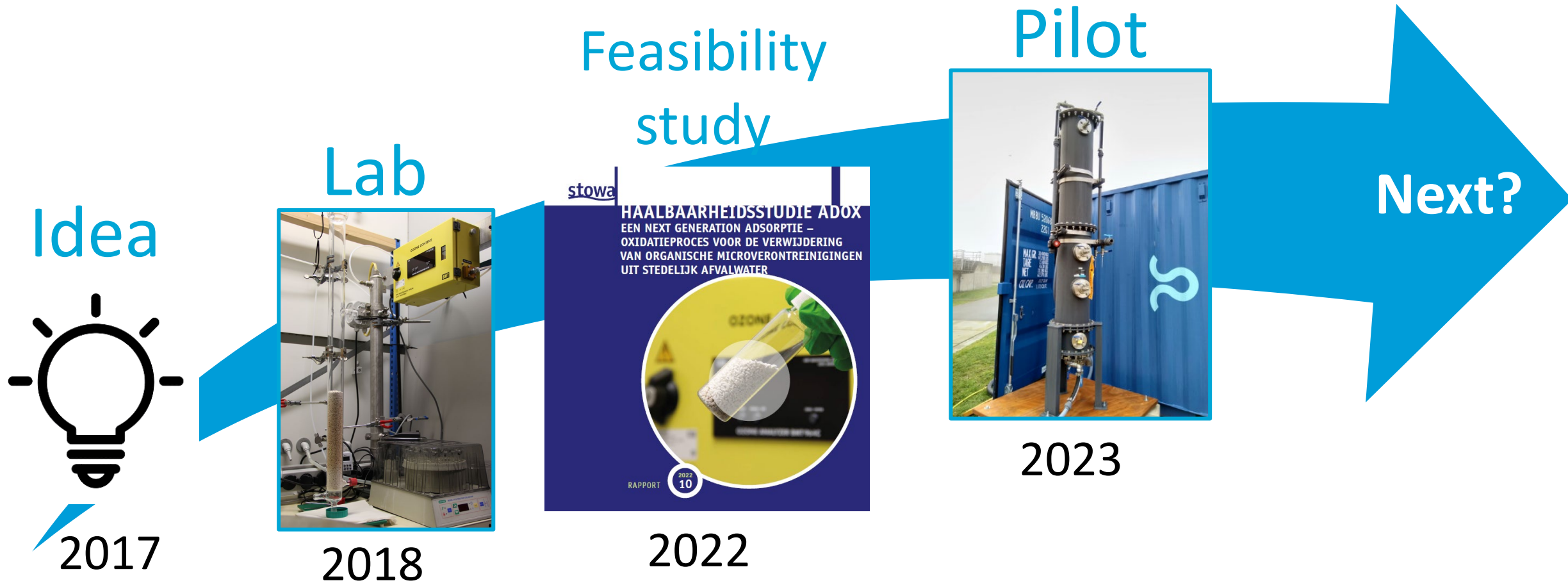


Less material and waste transport

AdOx process steps: adsorption - oxidation in 1 cycle



From lab to pilot: 5-year journey to TRL-5 & beyond



Pilot plant at AWZI Leiden-Noord: March – June 2023



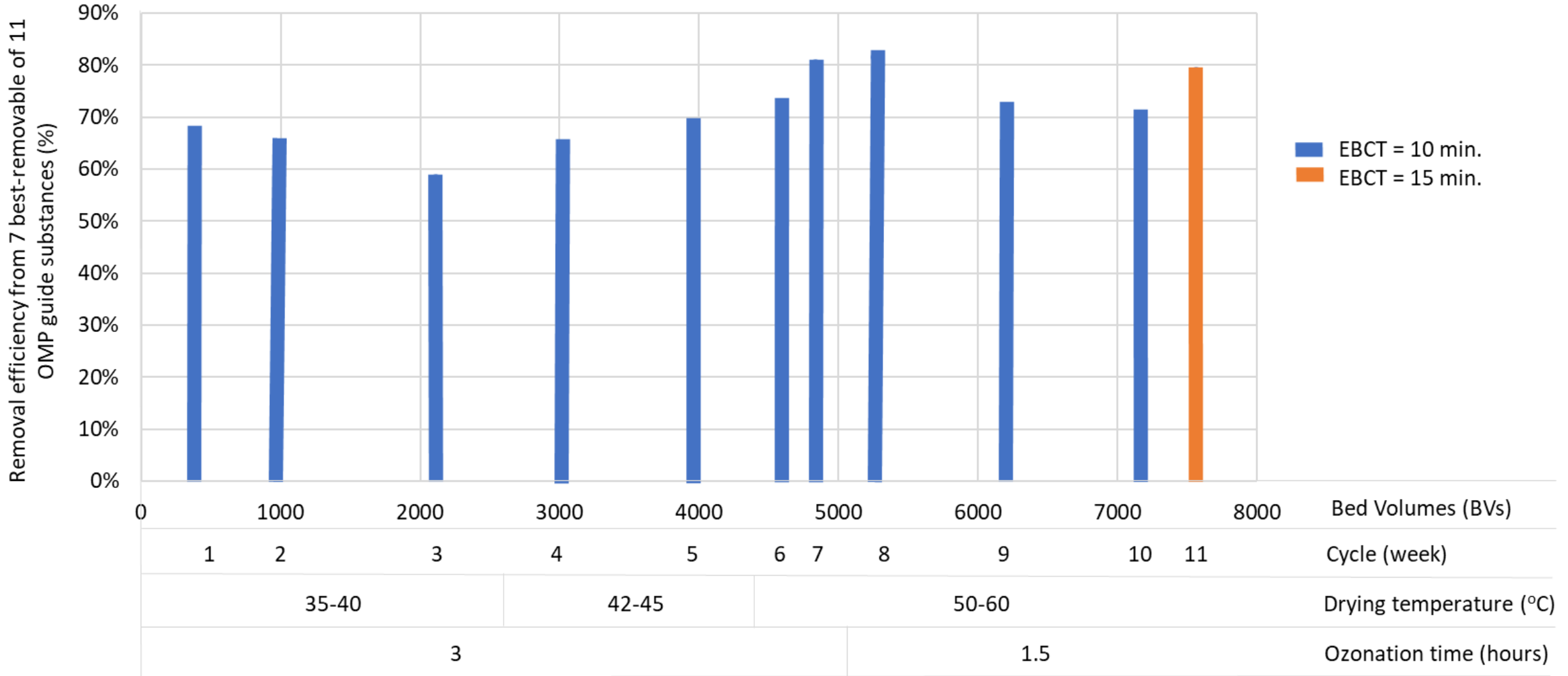
Influent flow rate = $0.5 \text{ m}^3/\text{h}$



Column height $\approx 3 \text{ m}$
Diameter $\approx 35 \text{ cm}$



Weekly average removal (60 – 85%) depends on drying and treated bed volume/week



Summary performances: AdOx (pilot plant) & IPMV reference technologies

	Unit	PACAS	Ozone + Sand Filtration	AdOx (EBCT 10 min.)	AdOx (EBCT 15 min.)
CO ₂ -footprint ¹	g CO ₂ /m ³	122	128	95	131
Costs ¹	€/m ³	0.05	0.17	0.13 – 0.21	0.15 – 0.27
Overall Removal Efficiency Dutch guide substances ²	%	70-75%	80-85%	67%	74%

¹ 1 Per treated m³ wastewater: peak dry weather flow must be treated. **Note: standardized cost and CO₂ levels for 2018; recalibration will take place in 2024**

² Overall Removal Efficiency of WWTP-effluent to WWTP-influent (including bypass post-treatment) for 7 of 11 guide substances: benzotriazol, carbamazepine, diclofenac, irbesartan, gabapentine, metropolol, hydrochloorthiazide, mixture of 4- en 5-methylbenzotriazol, sotalol, trimethoprim & venlafaxine in every 24h or 48h flow or time proportional sample. Hydraulic retention time of the WWTP is taken into account.

Next steps? Optimizing AdOx

2024

2025

H1

Labwork:
New zeolite granules
Process optimization

H2

New pilot operation
with a WWTP

H1

Adjustment period

H2

First demo-scale
project

Partner up? Updates?
Stay in touch!



Thank you for your attention!

Nessia Fausta

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**Tackling Micropollutants in Wastewater
Results of the Dutch Innovation and Implementation Program**

stowa



Rijkswaterstaat
*Ministry of Infrastructure
and Water Management*

November 8 and 9 2023
Aquatech Amsterdam