

AdOx

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



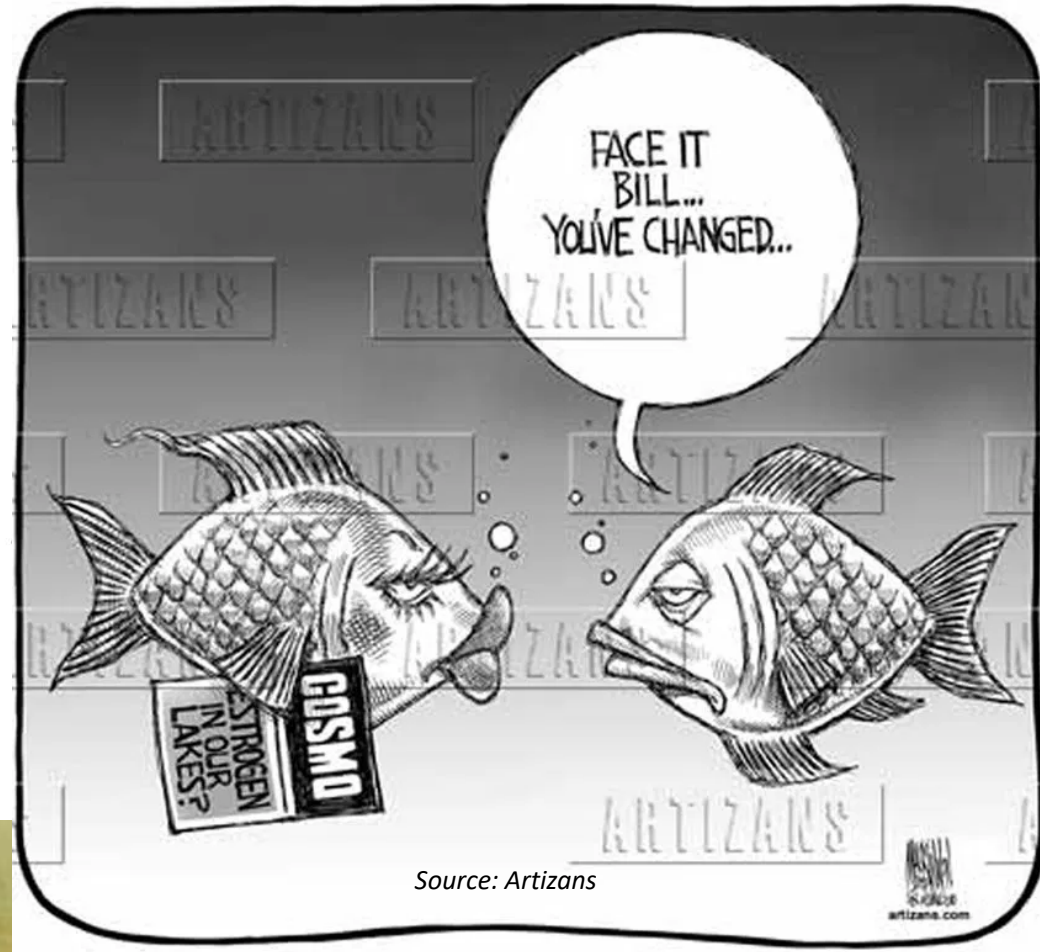
Nessia Fausta

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

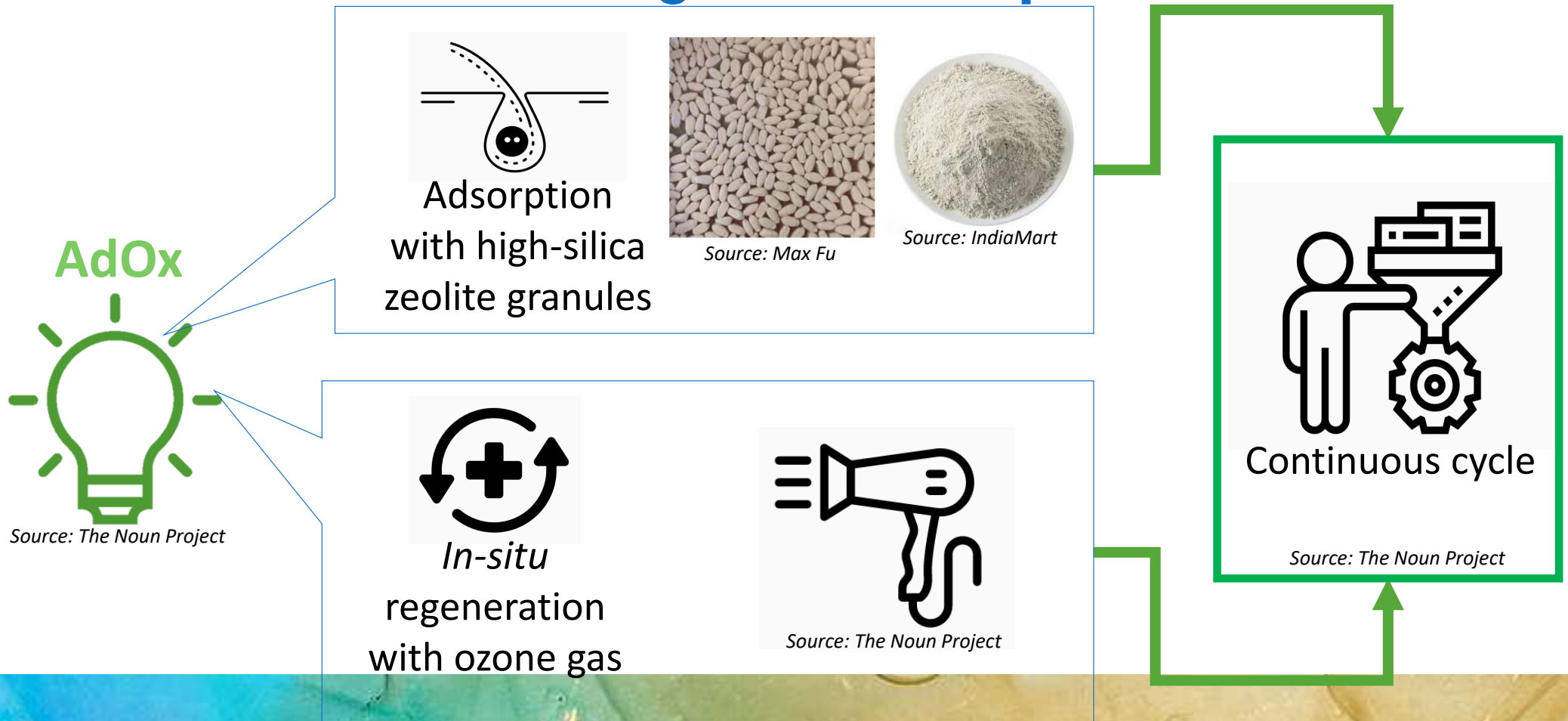
Organic Micropollutants (OMPs): a current driver in wastewater industries



Wastewater Treatment Plants
(WWTPs)



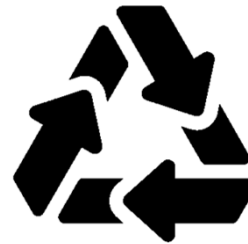
Idea behind AdOx: integrated adsorption – oxidation



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



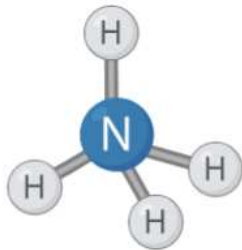
Min. 70% removal of OMPs
Min. 7 from 11 guide substances



Sustainable
(low CO₂ footprint)



Price competitive,
possibilities for
cost optimization



Polishing of ammonium (simultaneously)

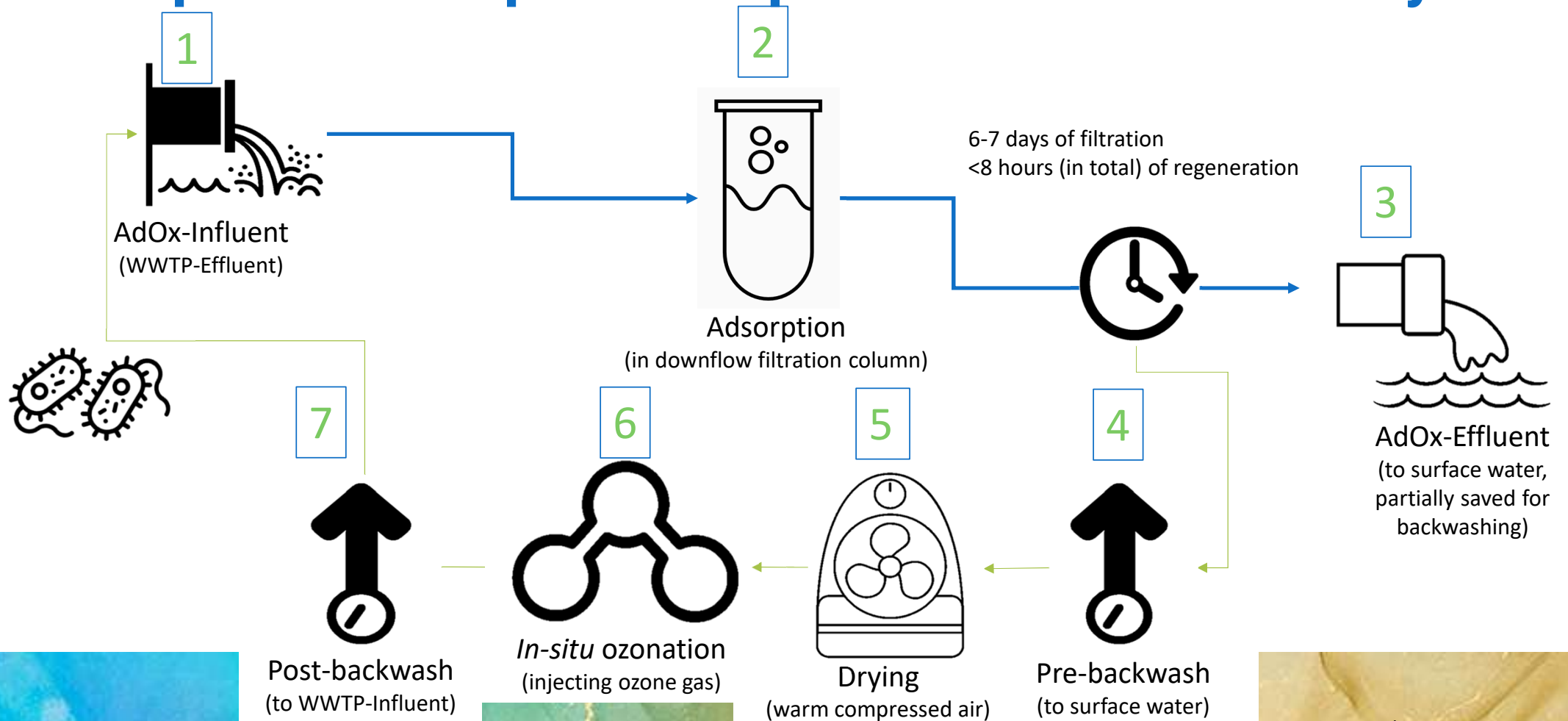


No bromate

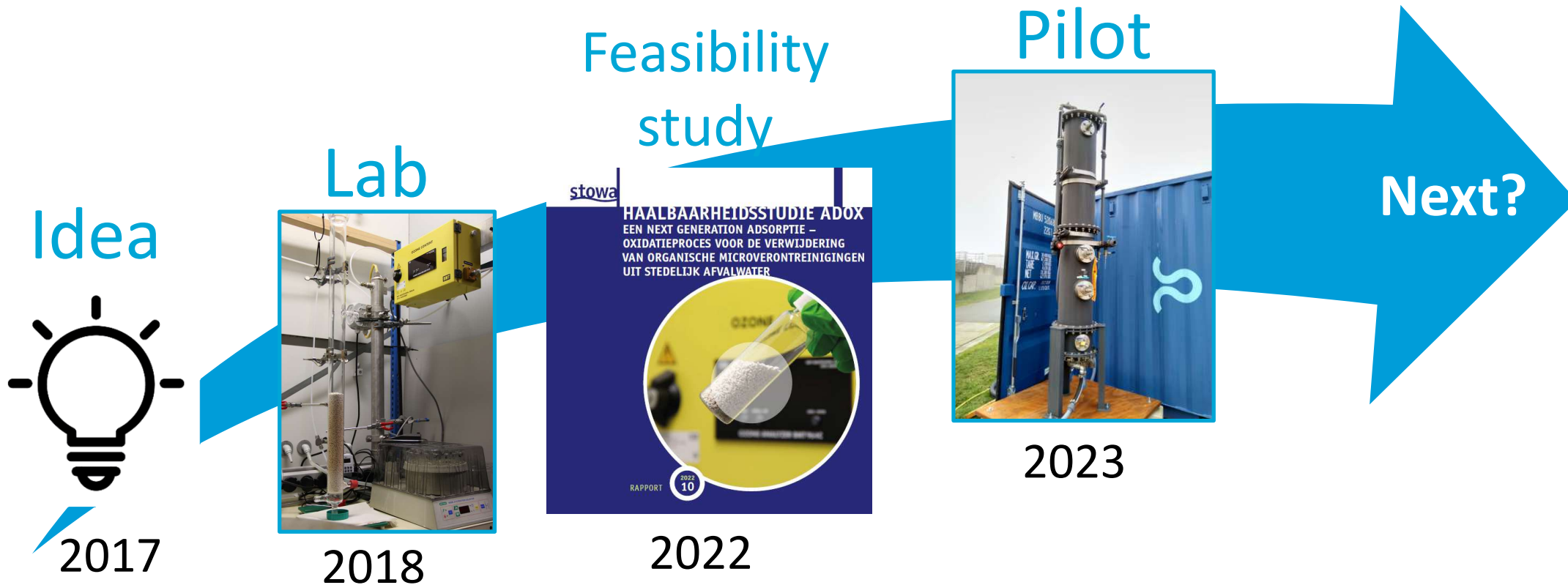


Less material and waste transport

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

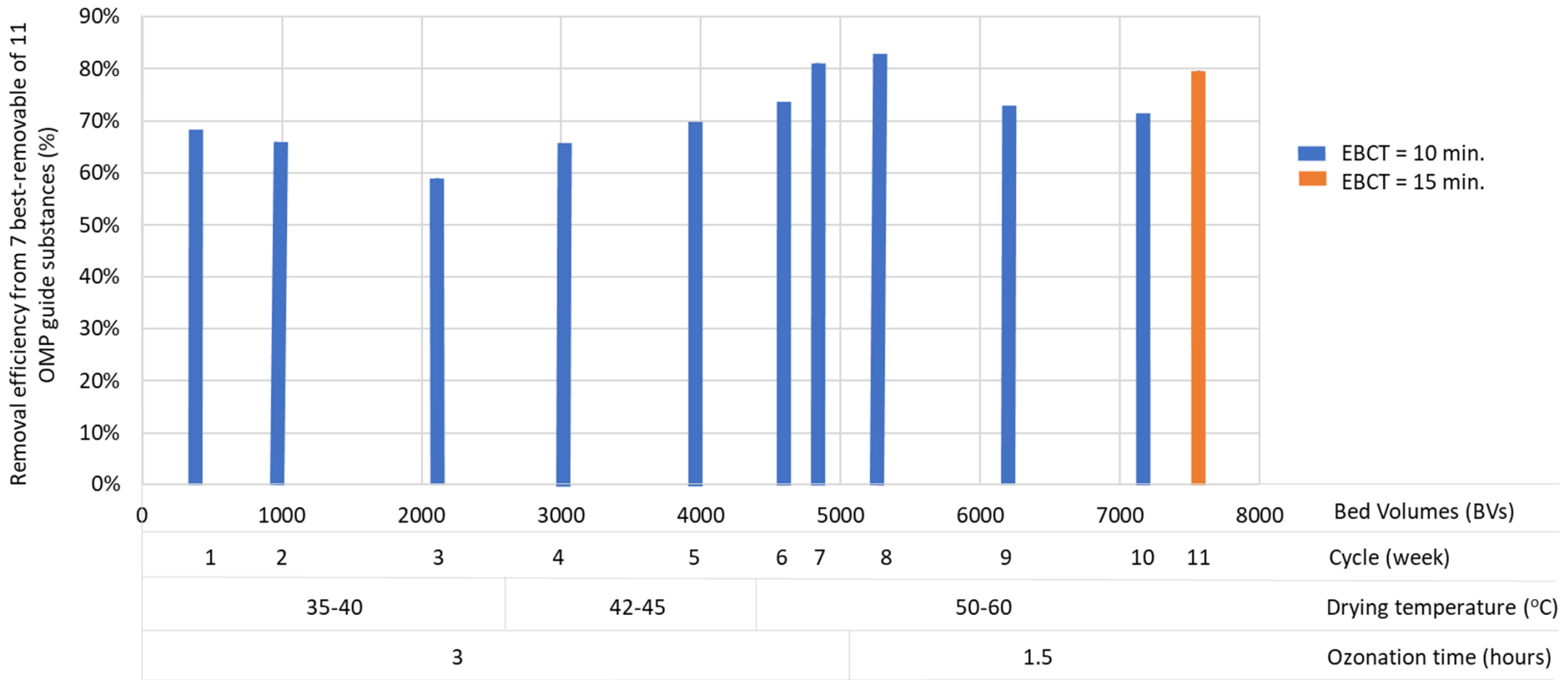


Column height \approx 3 m
Diameter \approx 35 cm

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



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 & venlaflaxine 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

TU Delft | Delft University of Technology

E n.fausta-1@tudelft.nl

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

**November 8 and 9 2023
Aquatech Amsterdam**

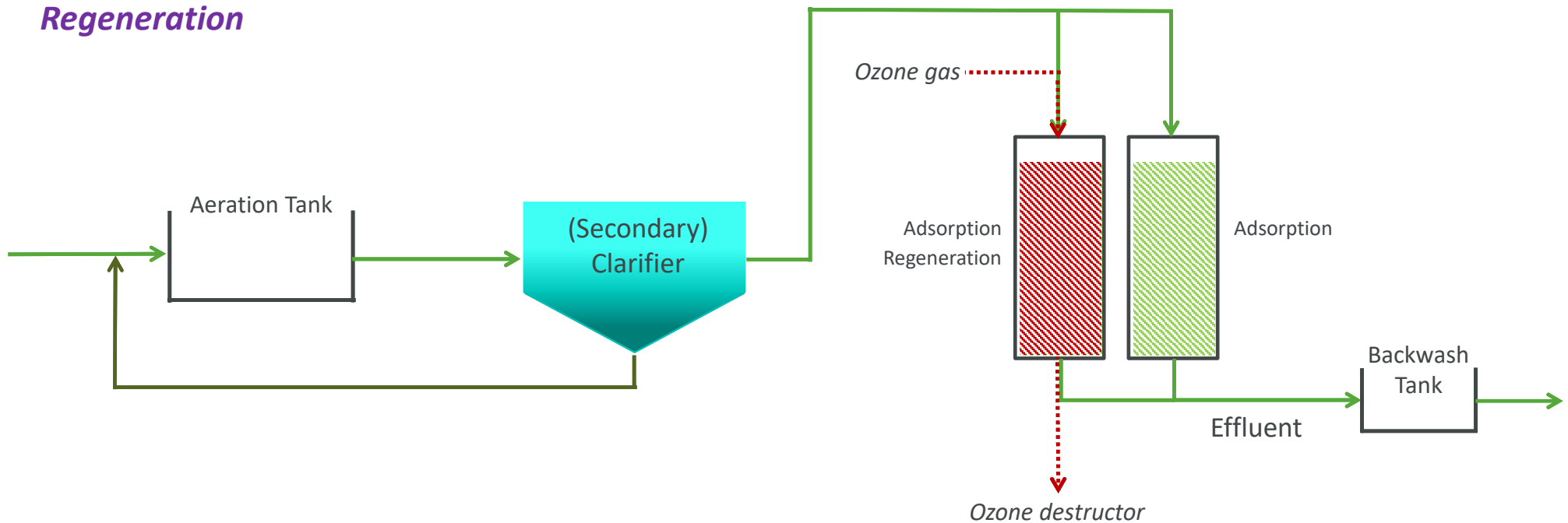
stowa



*Ministry of Infrastructure
and Water Management*

Integrated adsorption-regeneration process (full-scale setting: parallel columns)

Adsorption
Regeneration

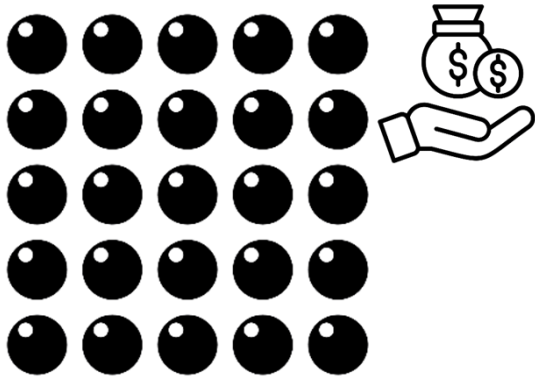


AdOx has advantages compared to current solutions that align with the priorities of WWTPs

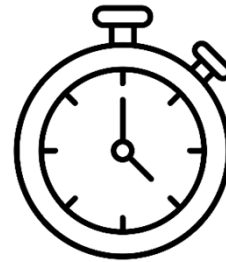
	AdOx	PACAS	O3SF	GAC
Treatment costs	+	++	-	-
CO ₂ -footprint	++	+	+	-
Removal rate	++	+	++	+
Bromate*	++	++	-	++
Transport costs	++	-	+	-
Waste	++	-	+	-

*) NL regulation for max. 1 µg/L in the surface water

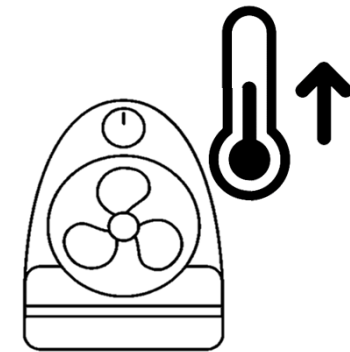
Next steps? Optimizing AdOx



Development of zeolite granules



Time:
EBCT, loading, regeneration



Drying



Ozonation

