

Full-scale MABR experience: intensification of nutrient removal & energy reduction

Water New Zealand
September 19, 2019

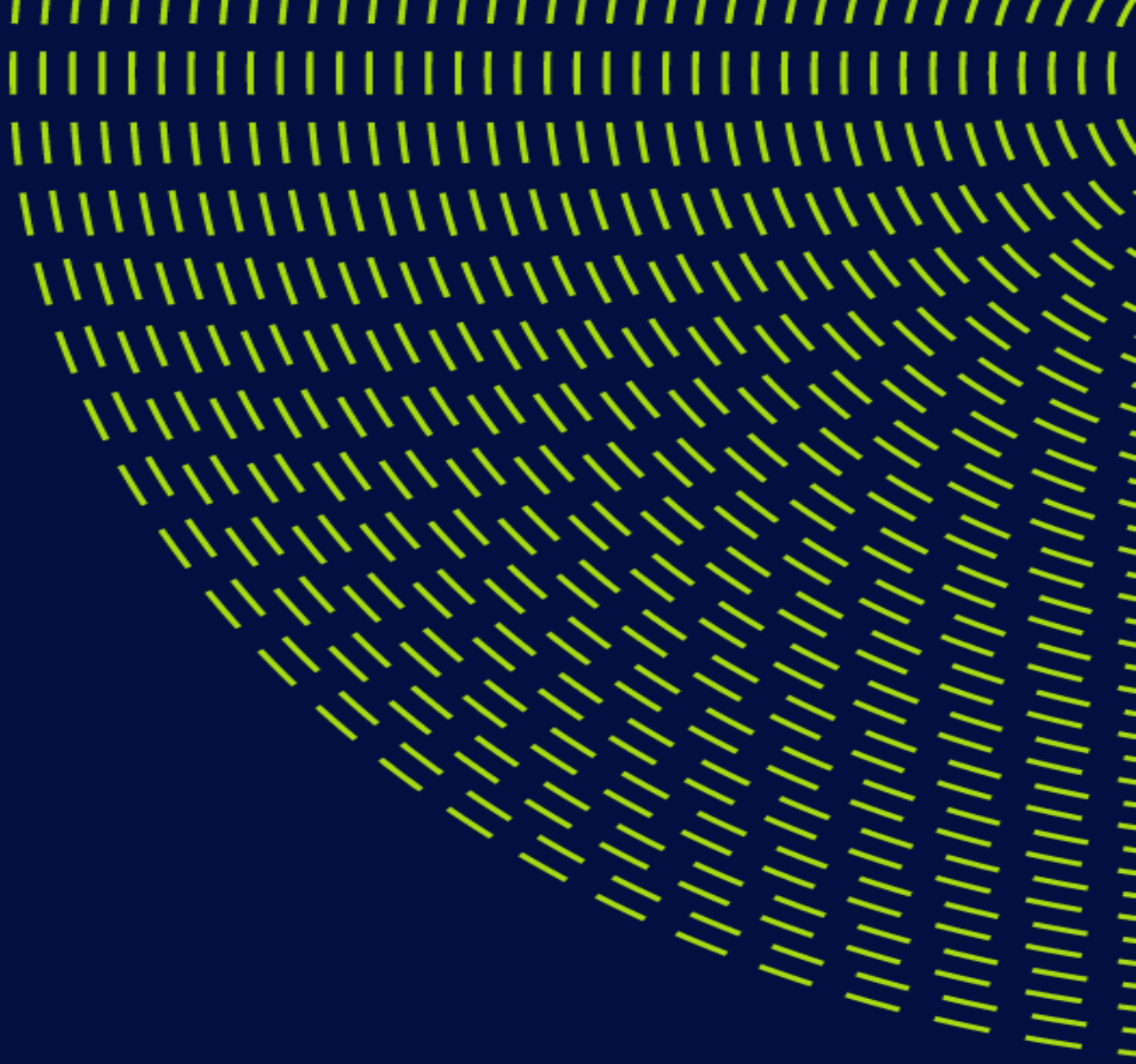
Jeff Peeters, P.Eng.



contents

- what it does
- how it works
- full-scale experience
- some interesting data

what it does



ZeeLung



an innovative & sustainable
solution to augment
wastewater plant performance

process intensification

up to 50% more treatment capacity in existing tank volumes

process resilience

improved resilience to upset conditions

simple solution

installed in existing tanks, no civil works, fast implementation

energy savings

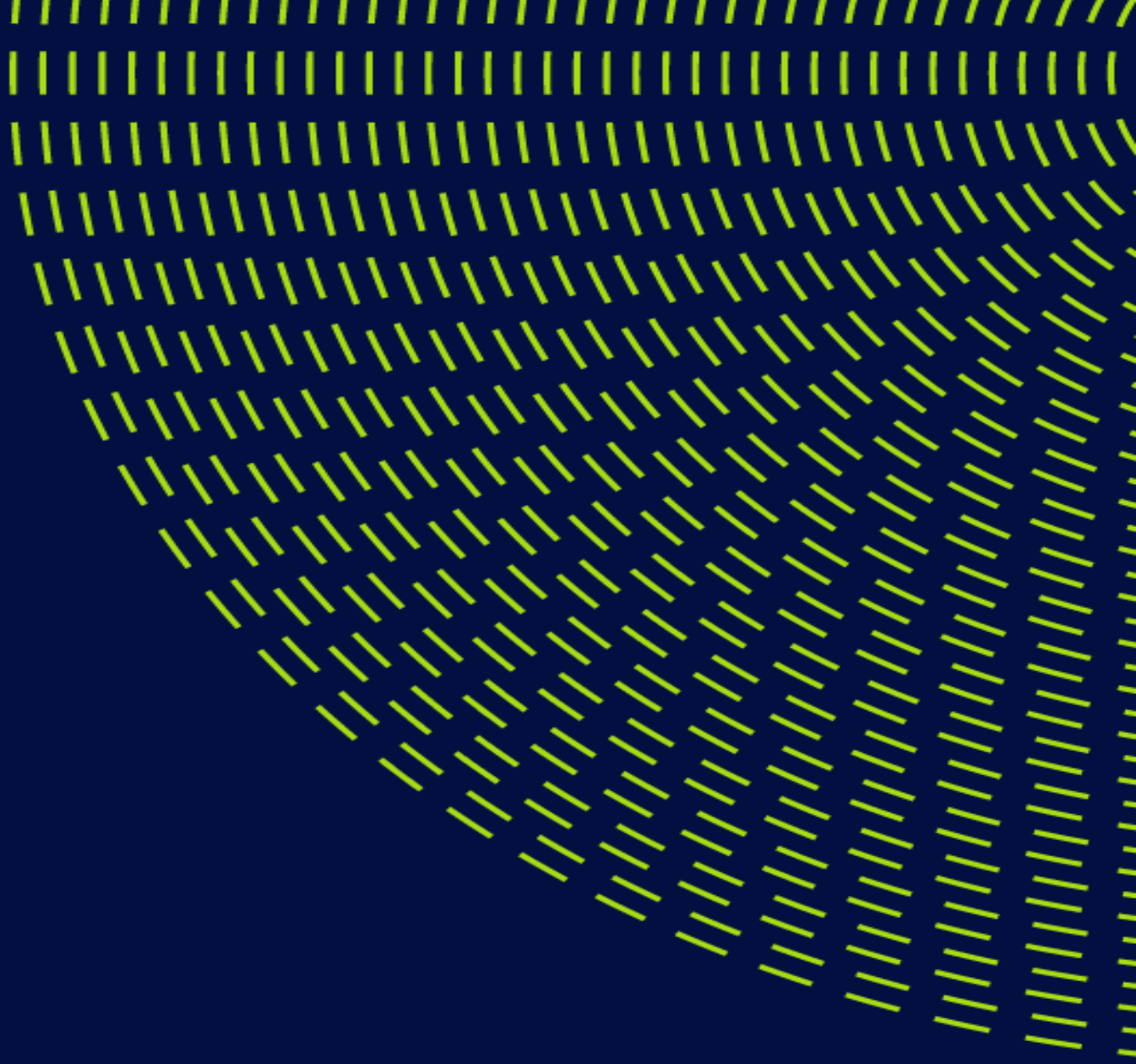
up to 50% less energy than IFAS

resilient, simple & sustainable wastewater process intensification

ZeeLung **solves** treatment challenges

- increase capacity
- augment ammonia removal
- implement nitrogen removal
- implement biological phosphorous removal

how it works



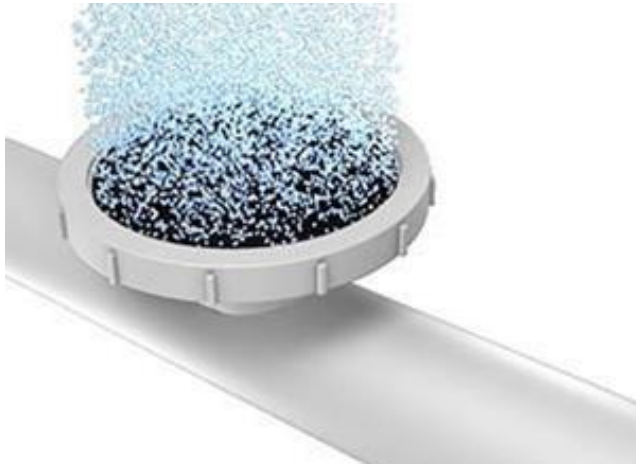
ZeeLung is a **biomass carrier** that supports the growth of a biofilm

the carrier material “**breathes**” and transfers oxygen to the biofilm at very **high efficiency** without the use of bubbles

ZeeLung is **not**...

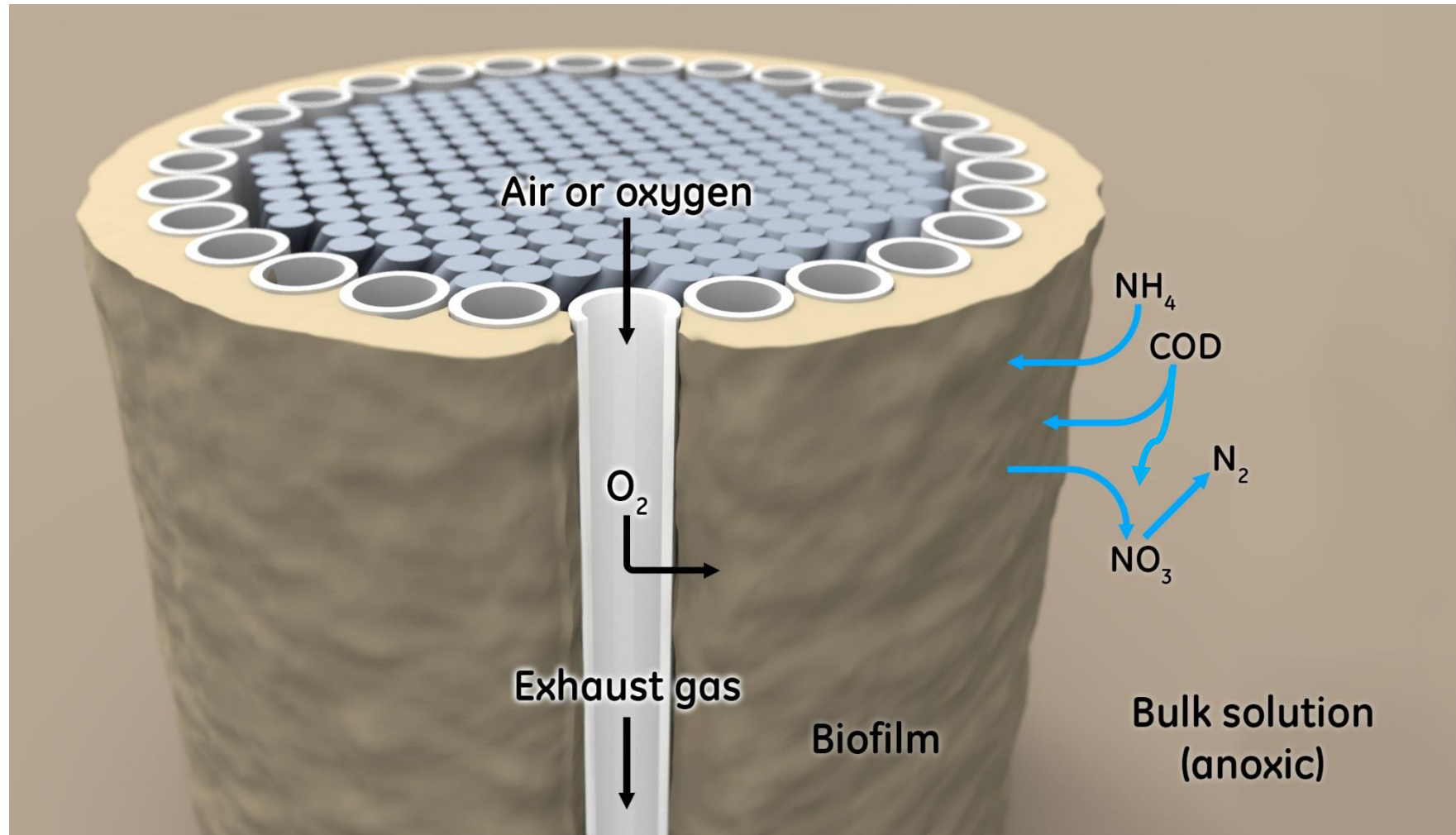


a filter

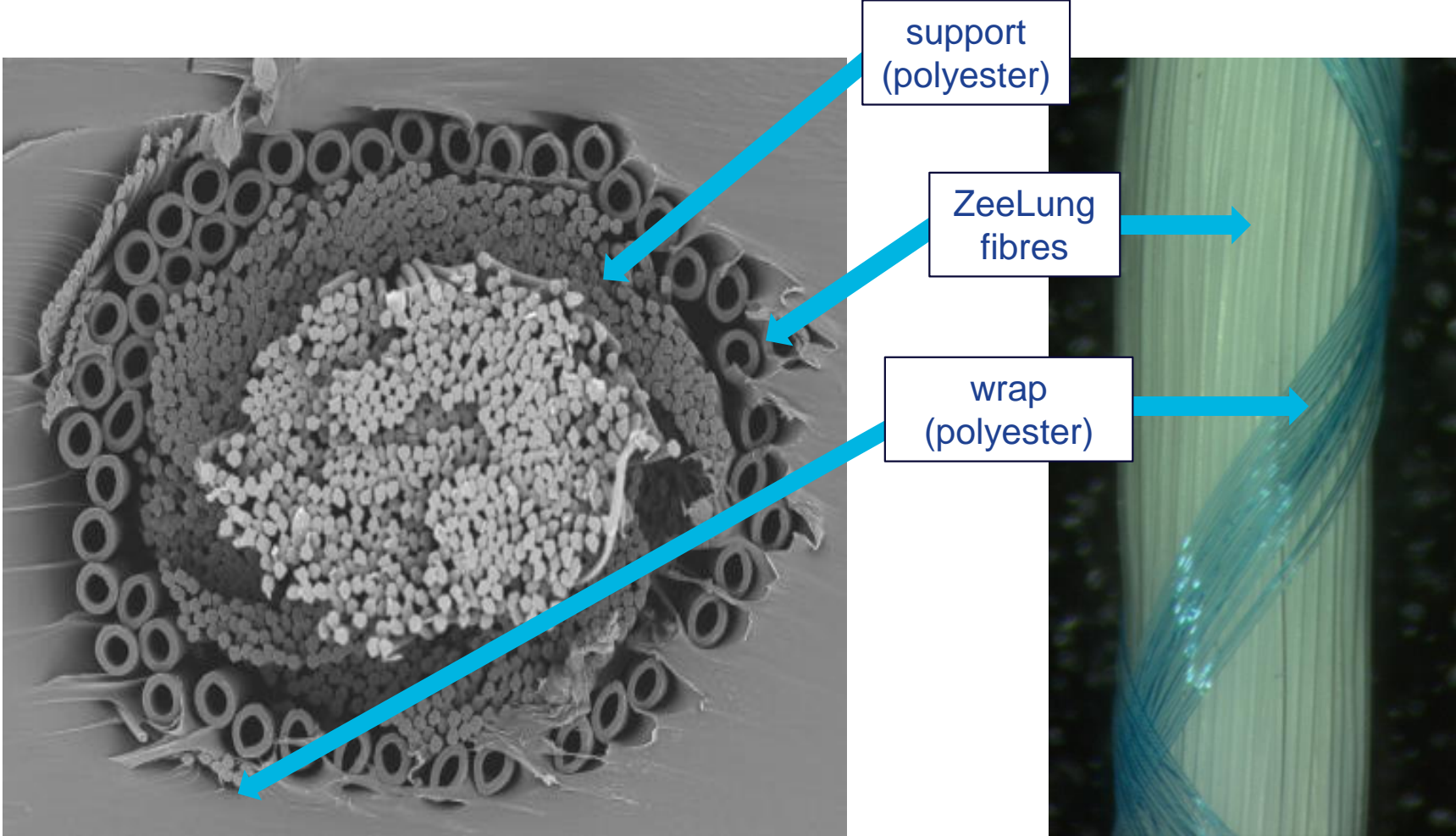


a fine bubble diffuser

ZeeLung process

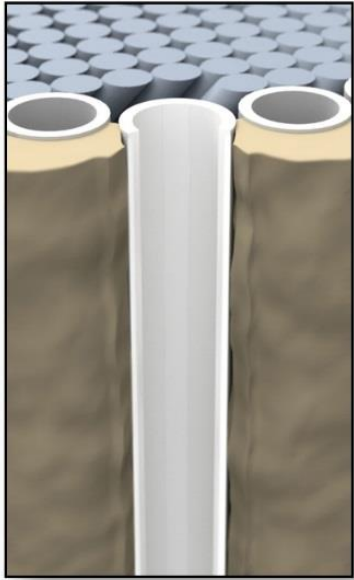


ZeeLung cord

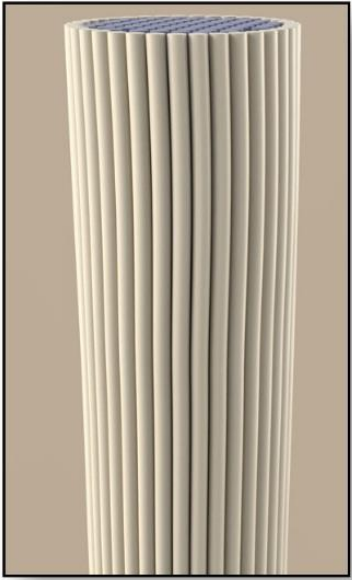


cord construction ensures product robustness

ZeeLung product



ZeeLung filament



ZeeLung cord

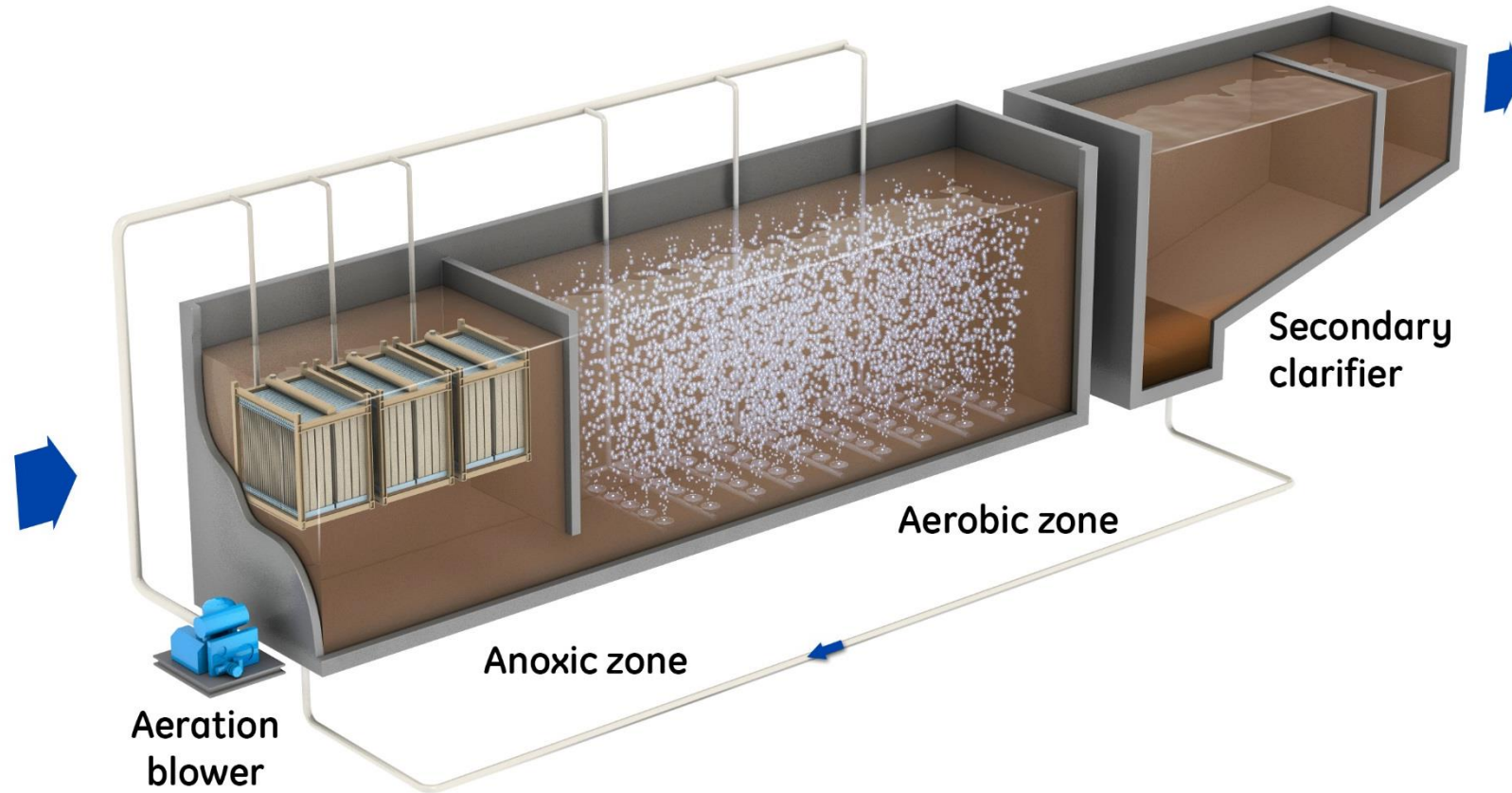


ZeeLung module



ZeeLung cassette

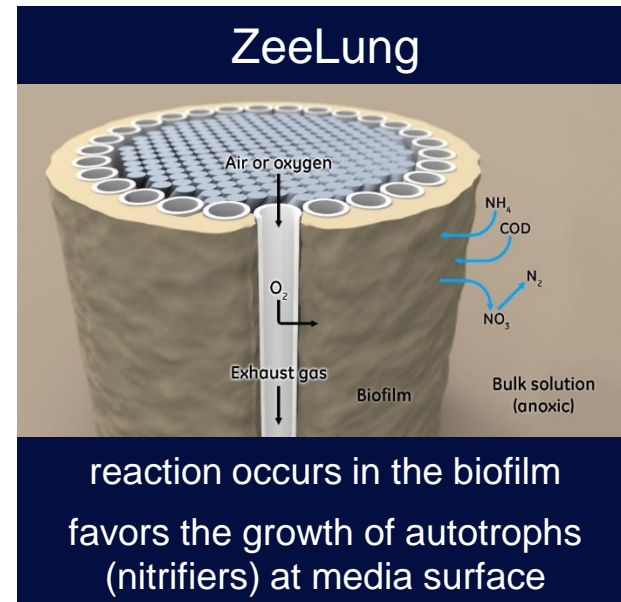
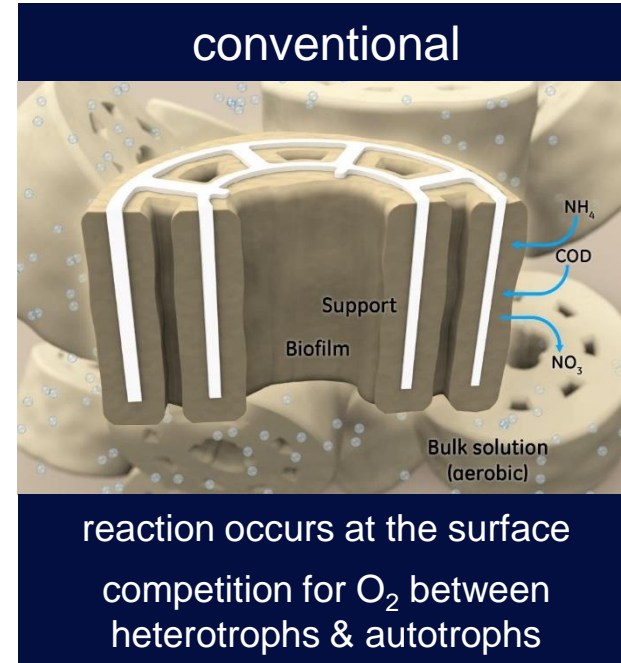
ZeeLung cassettes are installed in the bioreactor



increased biomass inventory in existing volume
enables nutrient removal & capacity expansion

ZeeLung enables process intensification

- \uparrow bacteria inventory =
 \uparrow treatment capacity
- plus... ZeeLung biofilm favors the growth of the bacteria we want – nitrifiers
- the result is even more
 \uparrow treatment capacity



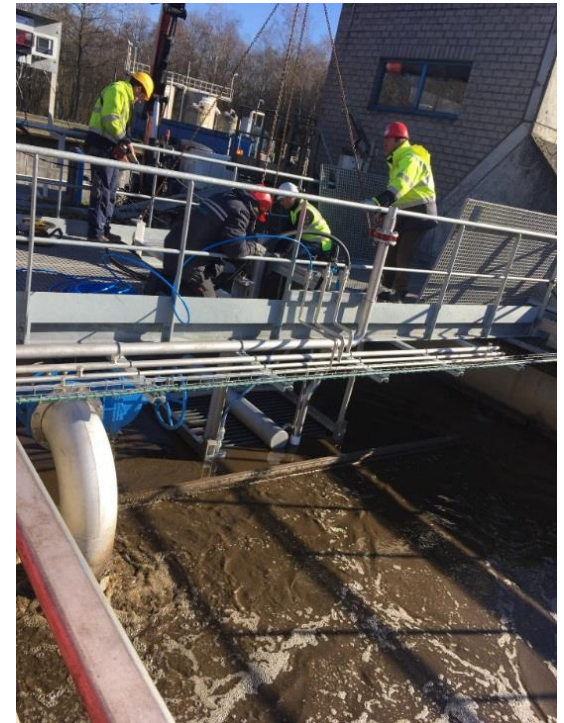
ZeeLung offers process resilience



- attached growth bacteria... not susceptible to washout
- rapid response to influent fluctuations
- stable cold temperature performance

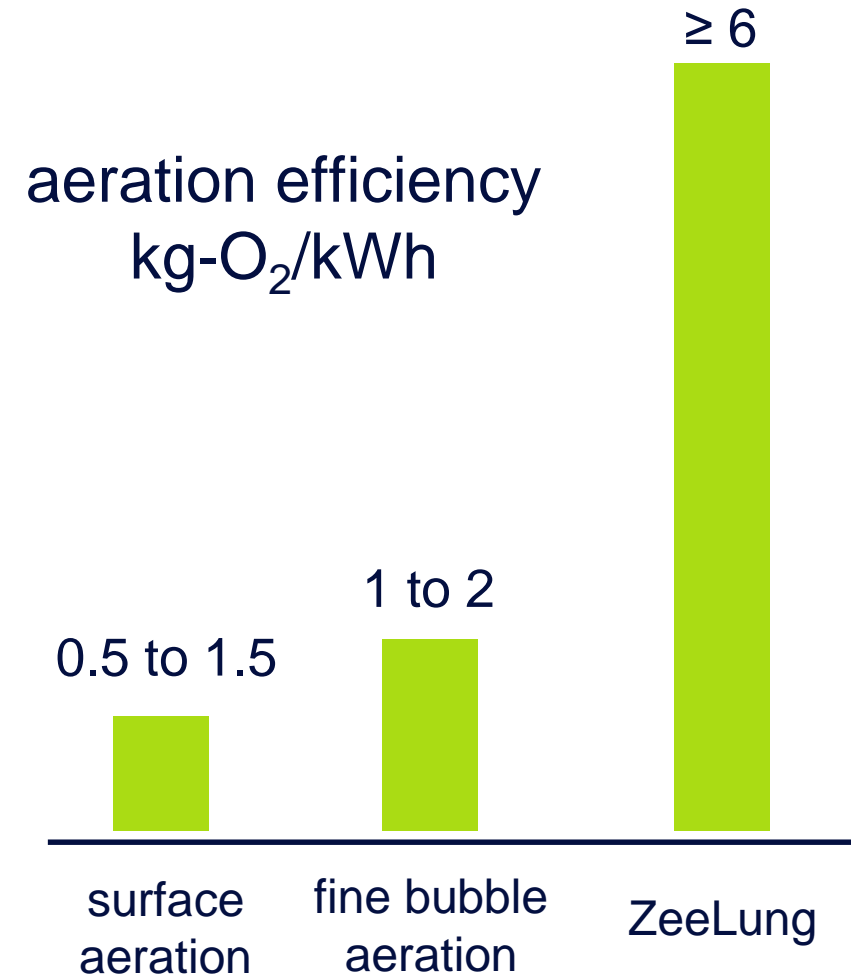
ZeeLung is a **simple** solution

- installed in existing tanks
- fast deployment
- no impact on hydraulic gradeline



ZeeLung **saves energy**

- transfer O₂ without bubbles
- 4X lower energy than bubble aeration
- reduce liquid pumping due to simultaneous nitrification & denitrification



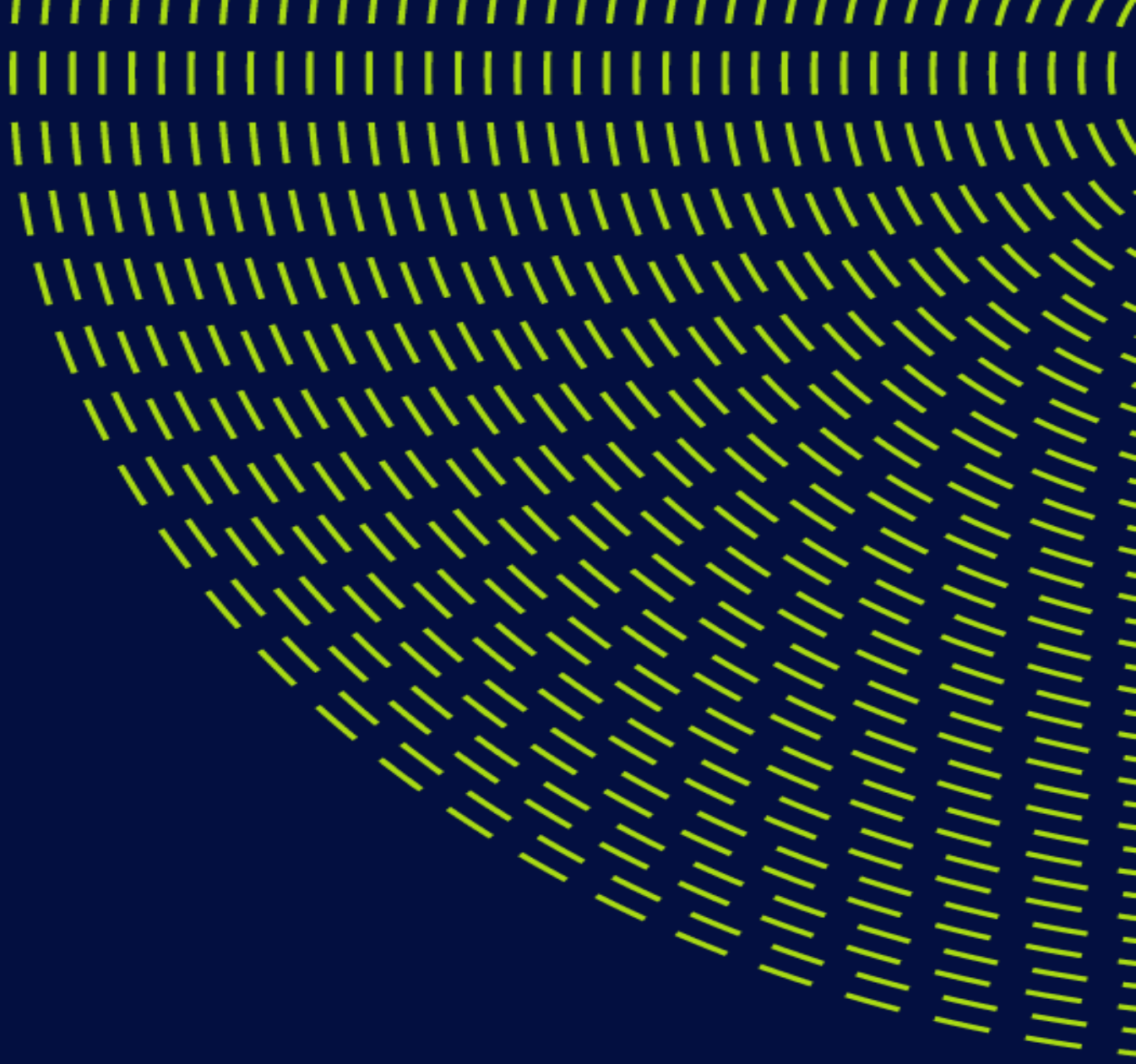
ZeeLung is a **sustainable** solution

- increase capacity of existing plant assets...
avoid building new tanks
- improve nutrient removal
- reduce energy
- no plastic pollution



IFAS media found on a beach, ref: Surfrider

full-scale experience



technology innovation through collaboration

20 MLD of full-scale installed capacity

>25 technology demonstrations

>10 research partnerships

21 patents issued

McARTHUR'S UNIVERSAL CORRECTIVE MAP OF THE WORLD

(Small text block on the map, likely a legend or explanatory text)



Yorkville-Bristol
Sanitary District,
USA



Schilde,
Belgium



Yorkville-Bristol Sanitary District

customer challenge

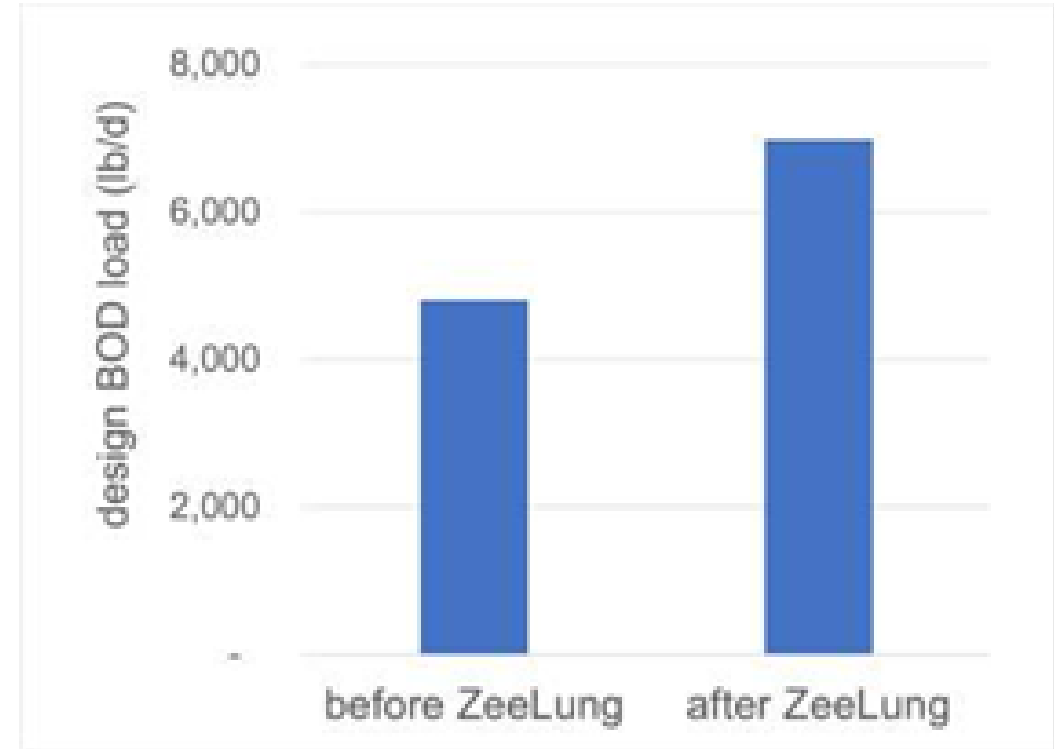
- CAS plant
- requires **upgrade** to treat **more load** (PE + industry) & meet **new TP limit**
- **footprint** constrained... CAS alternative requires new liquid line
- **time** constrained... new TP limit pending



Yorkville-Bristol Sanitary District

ZeeLung solution

- ZeeLung cassettes installed in existing basins
- 45% increase in capacity
- creation of anaerobic zone for bio-P
- no net increase in energy

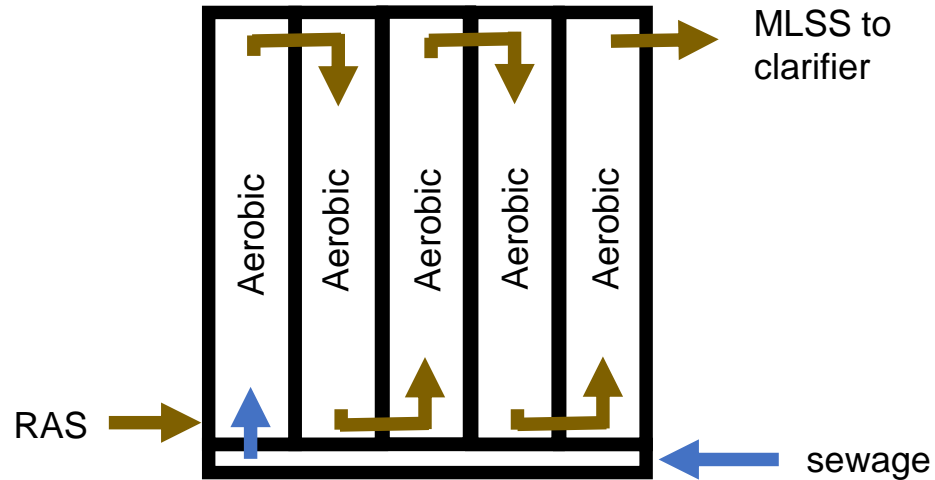


Yorkville-Bristol Sanitary District

ZeeLung implementation

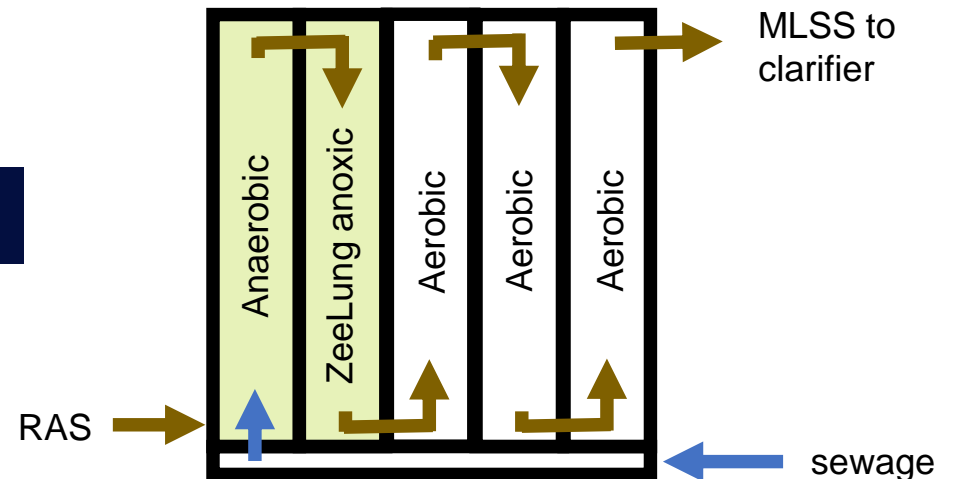


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before upgrade

after upgrade



Yorkville-Bristol Sanitary District

ZeeLung business case

	CAS	ZeeLung
CAPEX	\$25m	\$5m
construction duration	2-3 y	1 y

+ no net increase in energy



ZeeLung cassettes installed in existing tanks



Schilde, Belgium

drivers for Schilde

- 16 MLD plant
- two parallel processes – activated sludge & MBR
- new regulations require 65% TN removal

ZeeLung solution

- ZeeLung cassettes installed in existing activated sludge tanks
- increased biomass inventory enables creation of anoxic zone
- avoids the need to build new tanks

increased nutrient removal in existing tanks

ZeeLung upgrade benefits for Schilde

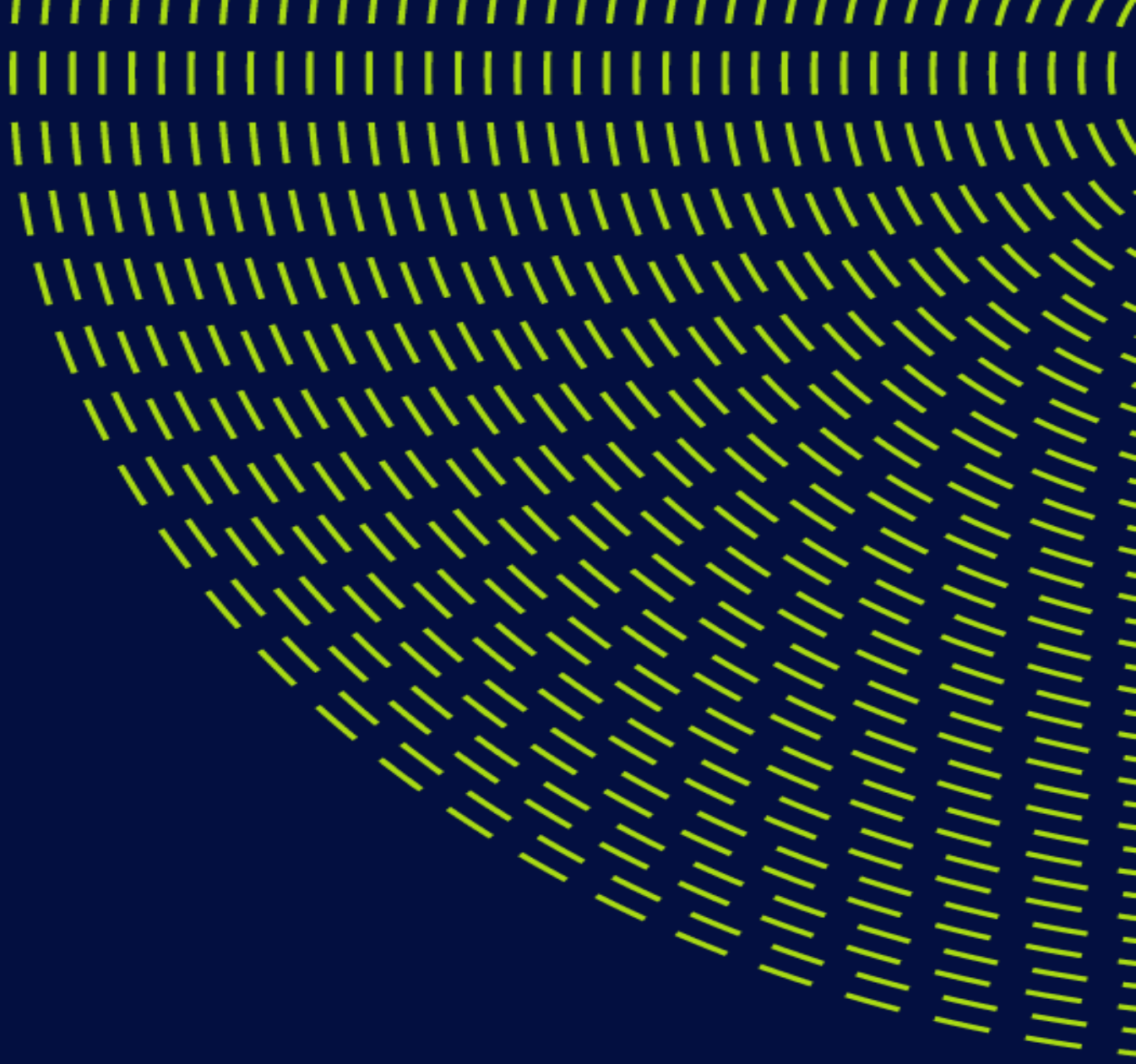
- more nutrient removal in existing tank volume
- reduce capex by avoiding new civil works
- no increase in energy





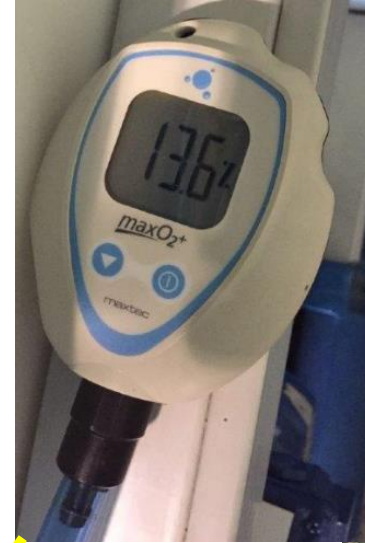
ZeeLung
cassettes
installed in
“live” tanks

some interesting data

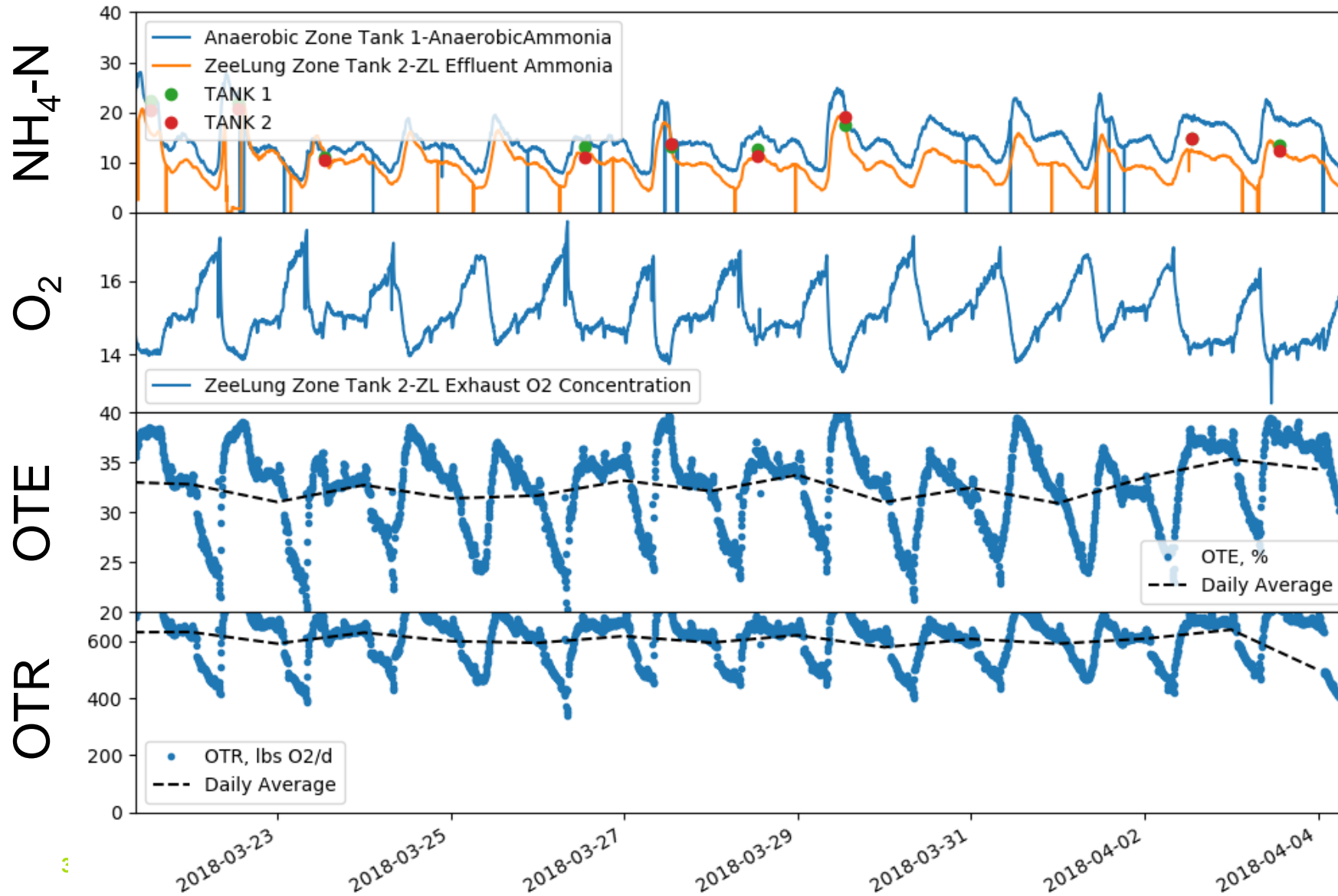


performance indicators

- exhaust O_2 ...
OTR (oxygen transfer rate),
OTE (oxygen transfer efficiency)
- N balance... sensors, sampling
- biofilm thickness... sampling & analysis

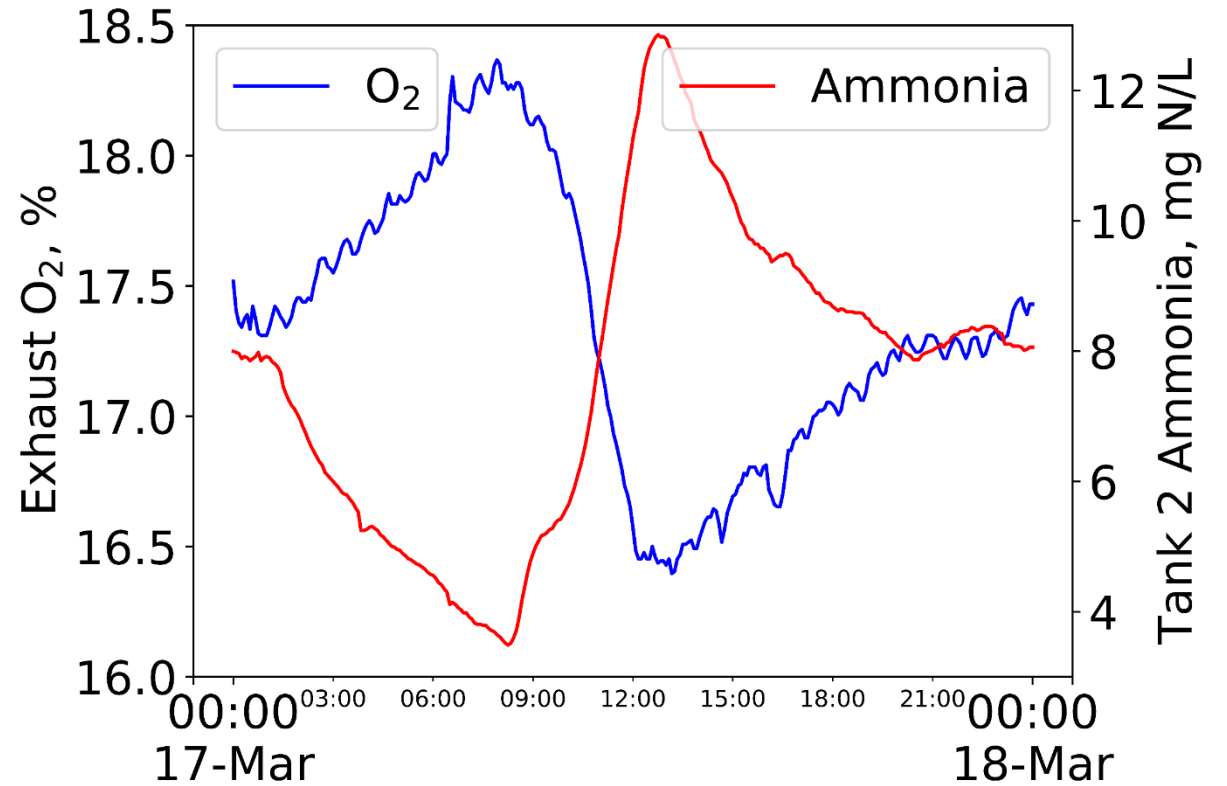
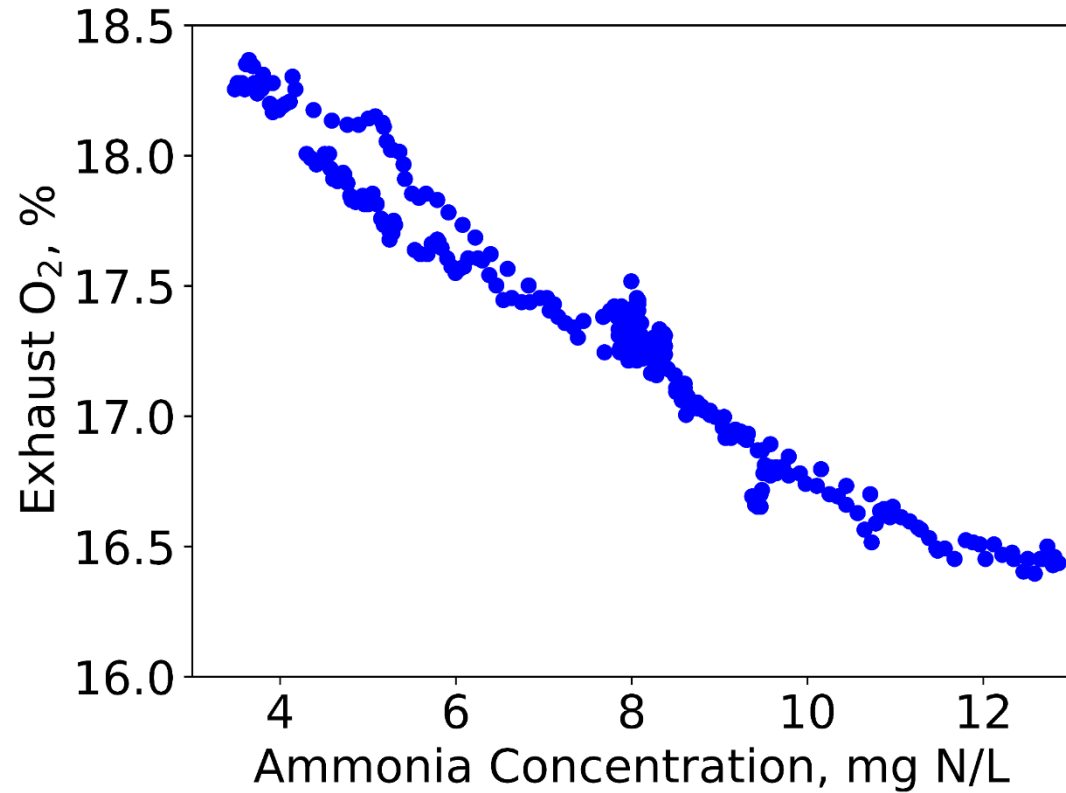


Yorkville performance

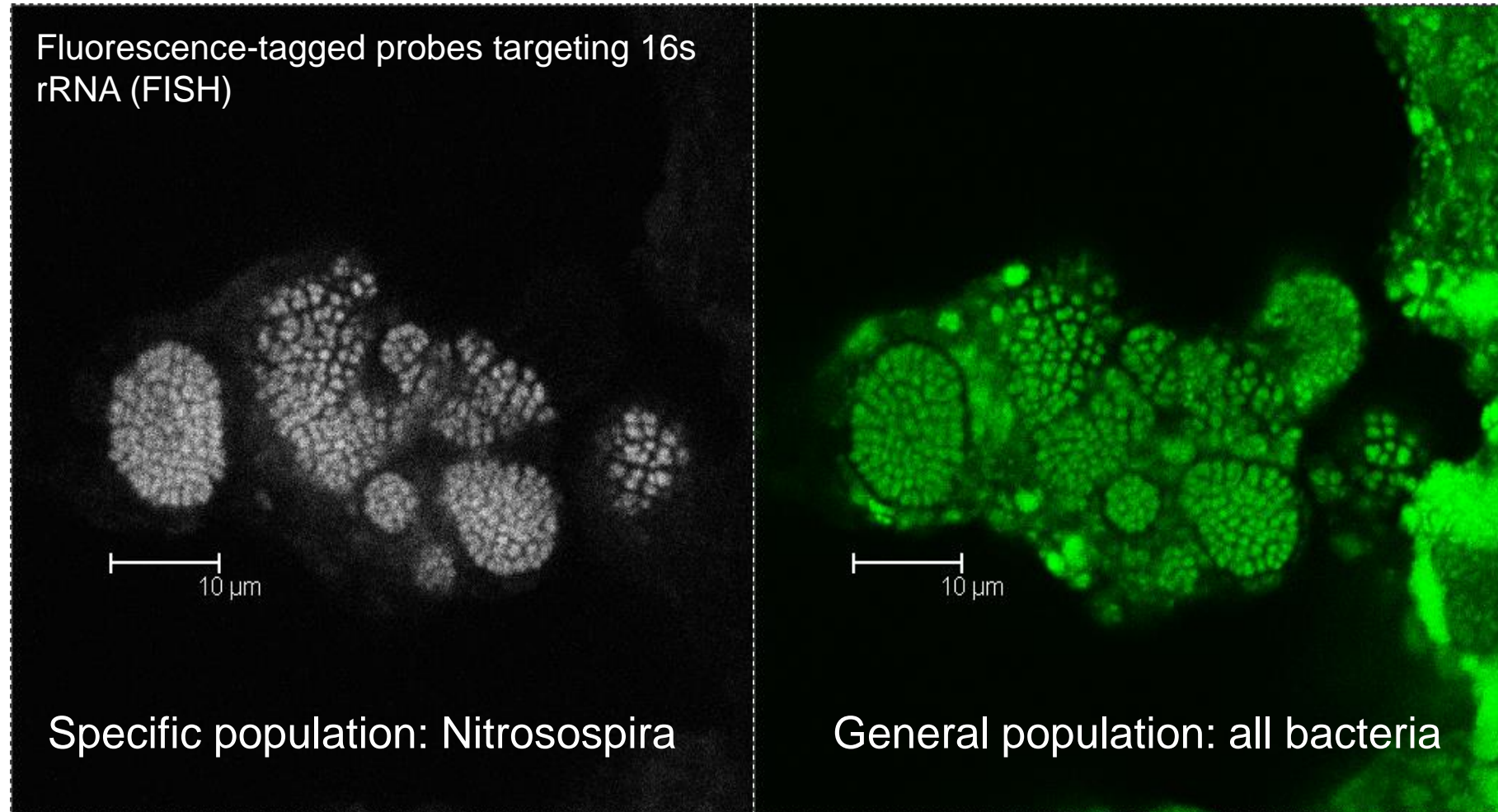


O_2 transfer strongly responds to bulk ammonia concentration

Yorkville performance



ZeeLung **biofilm community** qFISH results



ZeeLung biofilm community qFISH results

	Chicago		R1 of WW9		WW8	
	Before rinse	After rinse	Before scouring	After scouring	R1	R2
Nitrosomonas AOB (%)	1.7	2.7	4.8	7.6	21.0	15.4
Nitrosospira AOB (%)	12.6	9.7	1.8	0.9	3.2	4.5
Nitrospira NOB (%)	11.5	21.5	12	15.9	26.6	41.5
Nitrobacter NOB (%)	2.6	2.5	0.4	0.2	3.2	1.8
Total nitrifiers (%)	28.4	36.4	18.9	24.6	54.1	63.1

10X more nitrifiers than suspended growth floc

ZeeLung for pond treatment pilot in Canada



ZeeLung is an **innovative** technology

- solves big challenges...
footprint, energy, sustainability
- overcomes shortcomings of other
intensification processes...
complexity, energy, plastic pollution
- and more to come





thank you

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