

# Increasing treatment capacity with ZeeLung\* MABR technology an overview & case study

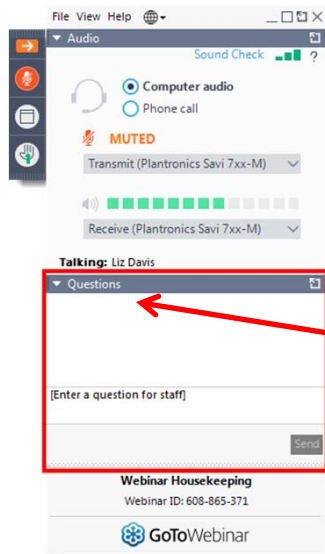
July 16, 2019



\* Trademark of SUEZ; may be registered in one or more countries

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## How to Participate Today



- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select “Use Telephone” and dial the conference (please remember long distance phone charges apply).
- **Submit your questions using the Questions pane.**
- **A recording will be available for replay shortly after this webcast.**

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## look who's talking

**Jeff Peeters, P.Eng.**  
senior product manager  
SUEZ Water Technologies & Solutions  
Canada



**Cyrus McMains, PE**  
executive director  
Yorkville-Bristol Sanitary District  
USA



**Dwight Houweling, PhD, P.Eng.**  
process team leader  
SUEZ Water Technologies & Solutions  
Canada



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## contents

- ZeeLung technology overview
- Yorkville-Bristol Sanitary District project
- performance results
- Q&A

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A dark blue slide with a pattern of yellow dashed lines on the right side. The text is in yellow and white. The Suez logo is in the bottom right corner.

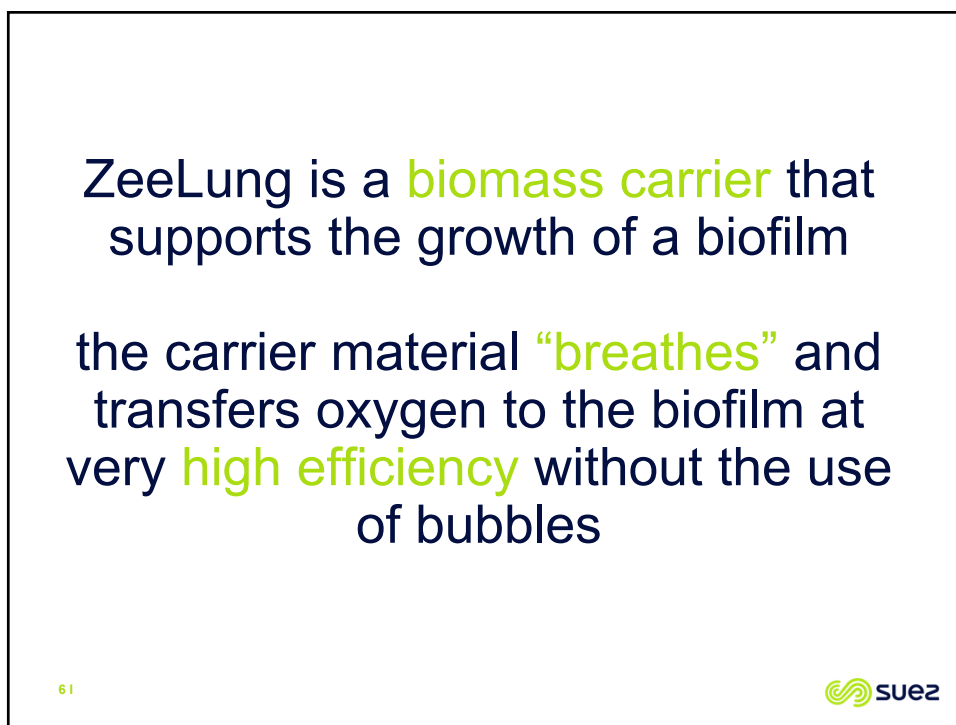
# ZeeLung technology overview

Jeff

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A white slide with a black border. The text is in black and yellow. The Suez logo is in the bottom right corner.

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

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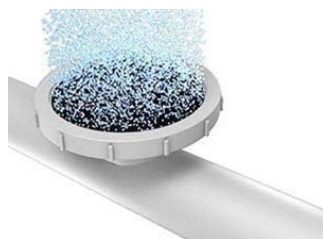


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## ZeeLung is **not**...



a filter



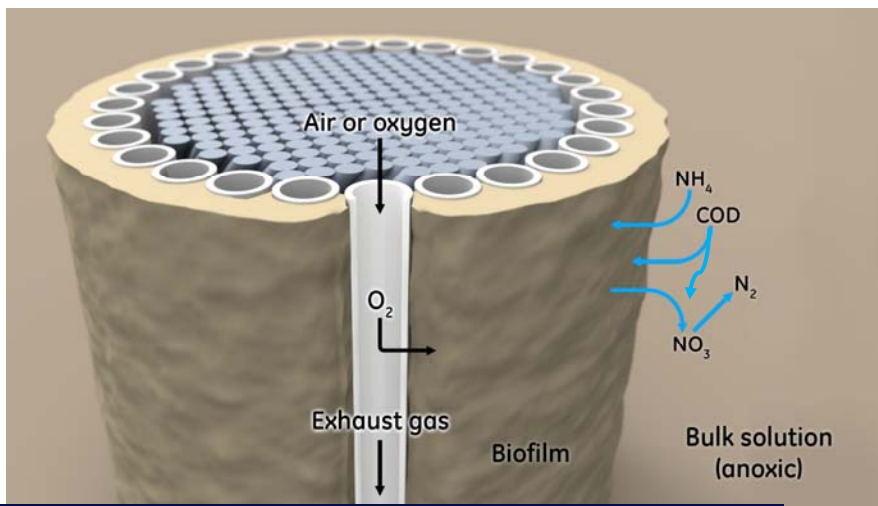
a fine bubble diffuser

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## ZeeLung process



highest efficiency of oxygen transfer by diffusion of  $O_2$  into a biofilm

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## ZeeLung cord

The image shows a cross-section of a ZeeLung cord on the left and a longitudinal view on the right. The cross-section reveals a central core of ZeeLung fibres surrounded by a wrap of polyester, all contained within a support of polyester. The longitudinal view shows the parallel arrangement of the ZeeLung fibres.

support (polyester)

ZeeLung fibres

wrap (polyester)

cord construction ensures product robustness

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## ZeeLung product

The diagram illustrates the manufacturing process of ZeeLung products in four stages: 1. ZeeLung filament (individual fibers), 2. ZeeLung cord (fibers bundled together), 3. ZeeLung module (cord mounted on a frame), and 4. ZeeLung cassette (module in a final housing).

ZeeLung filament

ZeeLung cord

ZeeLung module

ZeeLung cassette

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## ZeeLung cassettes are installed in the bioreactor

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

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## ZeeLung enables process intensification

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

**conventional**

reaction occurs at the surface  
competition for O<sub>2</sub> between heterotrophs & autotrophs

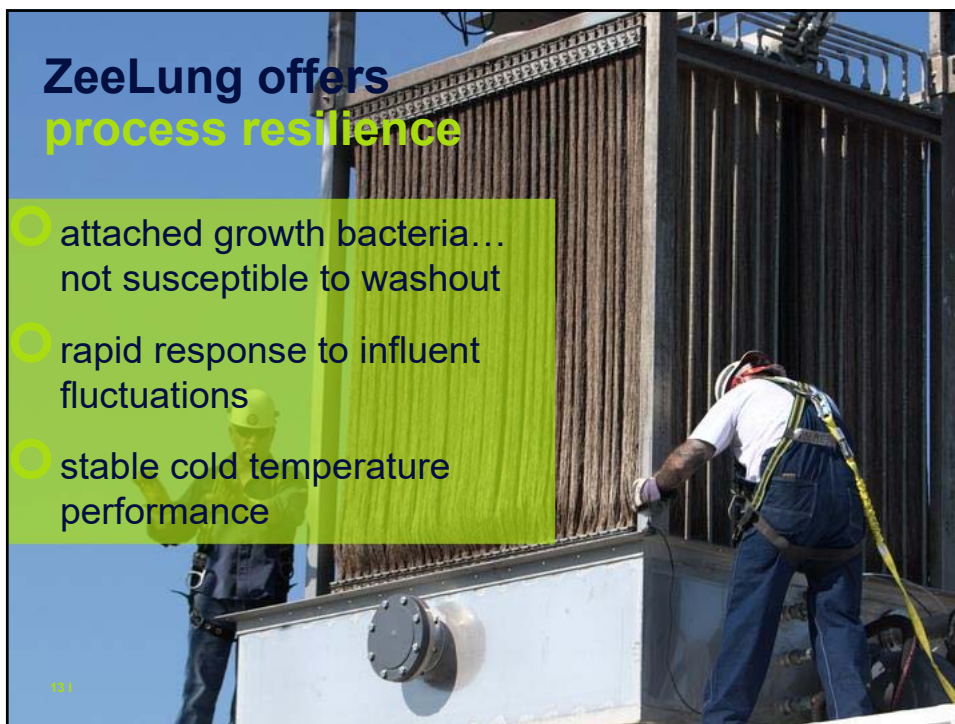
**ZeeLung**

reaction occurs in the biofilm  
favors the growth of autotrophs (nitrifiers) at media surface

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## ZeeLung offers process resilience

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



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## ZeeLung is a simple solution

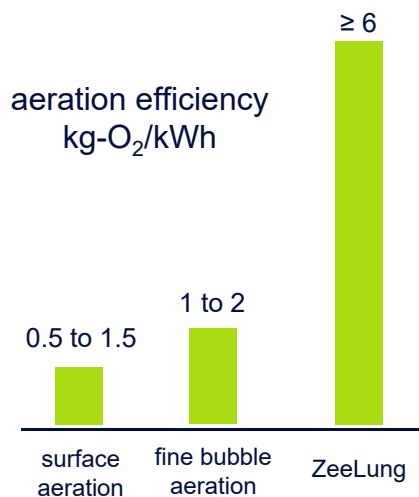
- installed in existing tanks
- fast deployment
- no impact on hydraulic gradeline



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## ZeeLung saves energy

- transfer O<sub>2</sub> without bubbles
- 4X lower energy than bubble aeration
- reduce liquid pumping due to simultaneous nitrification & denitrification



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## 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

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## treatment challenges that ZeeLung solves

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

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## technology innovation through collaboration

- 20** MLD of full-scale installed capacity
- >25** technology demonstrations
- >10** research partnerships
- 21** patents issued

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# Yorkville-Bristol Sanitary District project

Cyrus

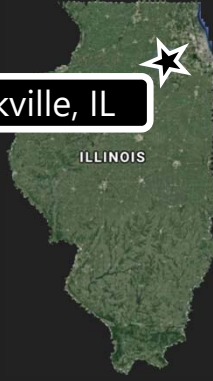
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## Yorkville-Bristol Sanitary District

- Serves 18,500 people
- 33.8 square mile FPA
- Wastewater treatment facility built in 1957
  - Major Upgrades: 1972, 1990, & 2001
  - Design Ave. Flow: 3.62 MGD (13.7 MLD)
  - Org. Capacity: 4,751 lb/d BOD (2,155 kg/d)



Yorkville, IL

ILLINOIS

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## Treatment Highlights

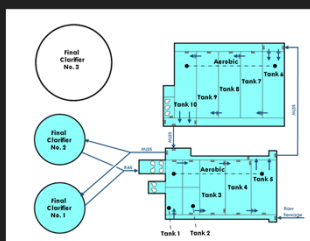
- 6-mm Bar & 1-mm Wedge Wire Screens
- Activated Sludge
  - Single Stage Nitrification – Prior to 2017
  - Fine Bubble Aeration Panels
  - Centrifugal & PD Blowers
  - Airlift RAS Pumps
- Ultraviolet Disinfection
- Autothermal Thermophilic Aerobic Digestion (ATAD)
- Centrifuge Dewatering



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## Activated Sludge Operation – Prior 2017

Series



- Two single-stage nitrification trains
  - Train 1: Tanks 1-5 to Clarifiers 1 & 2
  - Train 2: Tanks 6-10 to Clarifier 3
- Series operation during Average Flows
- Parallel operation during Wet-Weather Flows

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## Project Drivers

- New Total Phosphorus (TP) Effluent Limit
  - Annual Average TP of 1.0 mg/L
- Rapid population increase affect on per capita Influent Loading:
  - BOD increase
    - 2001 Avg. Loading: 157 mg/L
    - 2012 Avg. Loading: 215 mg/L
  - Industrial Dischargers
    - High strength: 10% of BOD capacity
    - Low flow: 1% of Hydraulic capacity
- Site Constraints
  - Existing treatment site is built-out
  - Any significant capacity increase will require construction of a new treatment facility west of Blackberry Creek



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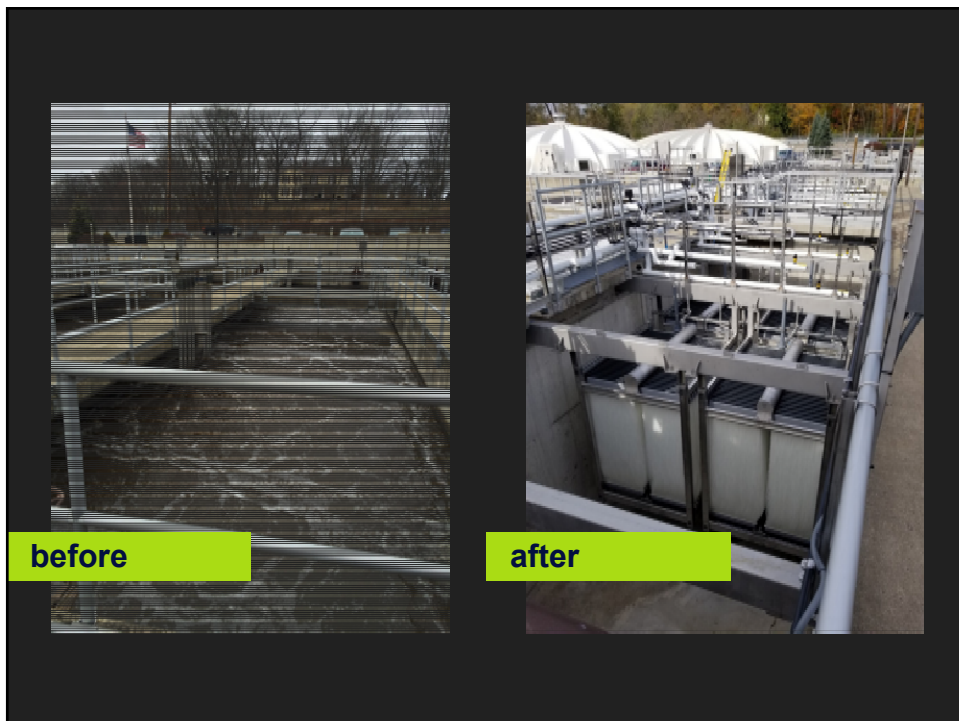
## ZeeLung at YBSD

- SND in the ZeeLung zone reduces the nitrate loading to anaerobic zone which improves enhanced biological phosphorus removal (EBPR) performance
- Increase of BOD treatment capacity within existing footprint
- Minimizes impact of industrial loads on treatment capacity
- ZeeLung implementation cost < 25% new treatment facility
- Increase in capacity without increase in energy consumption
- Implement with EBPR within 18 months

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# performance results

Dwight

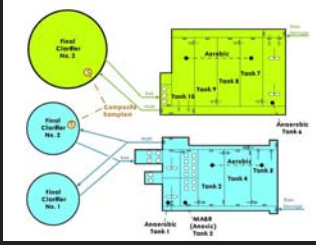
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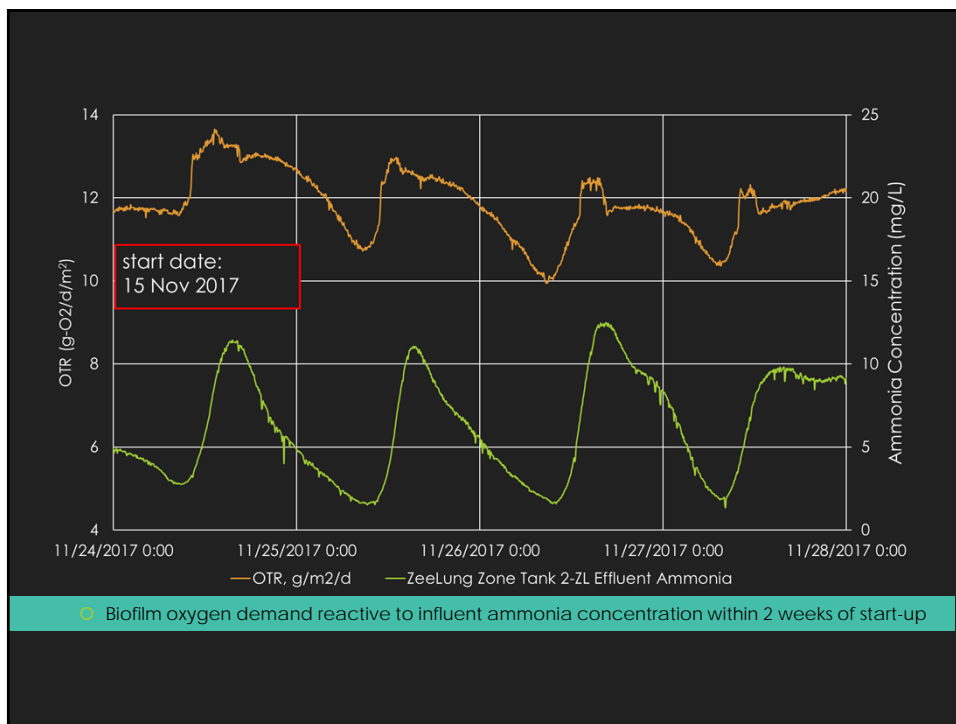
## Start-up Protocol

- Mixed liquor and influent wastewater introduced on November 15, 2017
- Operated in Parallel to initially limit flow to MABR
- Influent was initially brought in at 50% of the design load to establish biofilm
- Influent loading was stepped up to the design loading over a 6 week period.

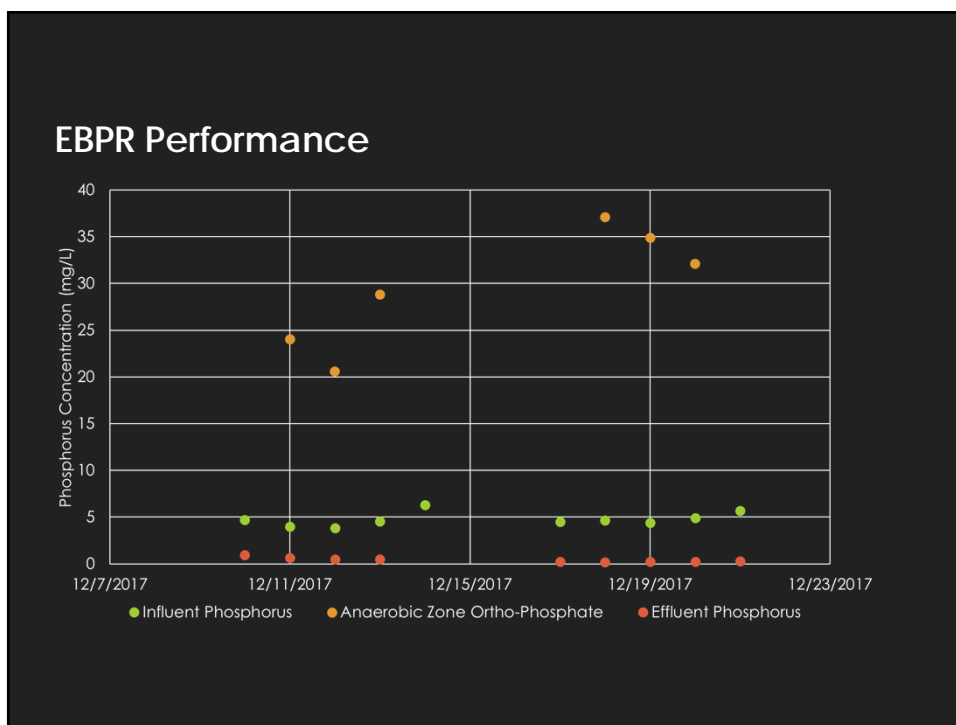
Phase 1 Startup (first 2 months)



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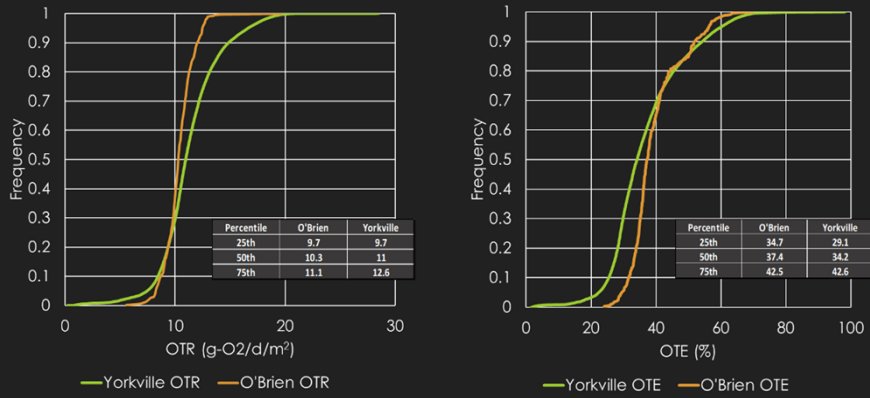


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## Comparing Performance

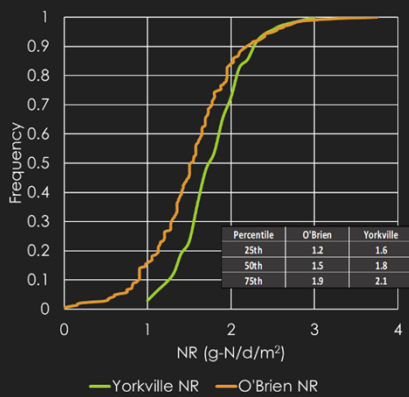


ZeeLung performance at full-scale is consistent with demonstration experience

O'Brien data adopted from Kunetz et al., 2016

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## Comparing Performance ... continued



O'Brien data adopted from Kunetz et al., 2016

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## Microbial Analysis

| Sample Source              | March 2018          | April 2018             |
|----------------------------|---------------------|------------------------|
| Sampling Method            | ZeeLung cord        |                        |
| Quantification Method      | qPCR <sup>(1)</sup> | RT-qPCR <sup>(2)</sup> |
| Total Nitrifier Population | 40.5% ± 12.2%       | 29.5% ± 23.5%          |

<sup>(1)</sup> amoA as primer for AOB; 16s rRNA primers for NOB  
<sup>(2)</sup> Quantitative reverse transcription PCR: RNA is transcribed into DNA, which is then used for qPCR analysis

- Typical nitrifier population in MLSS is 6-8%.
- ZeeLung biofilm is dominated by nitrifiers due to the counter-diffusion of O<sub>2</sub> in the biofilm.

○ Abundance of nitrifiers on the ZeeLung when compared to MLSS

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# Q&A

Jeff

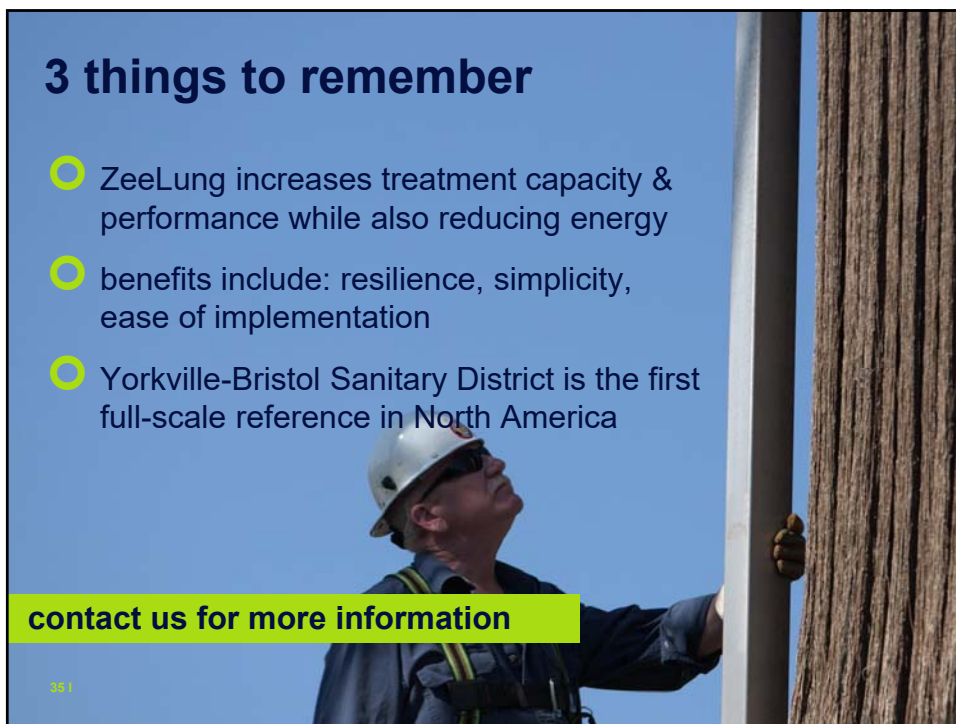
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## 3 things to remember

- ZeeLung increases treatment capacity & performance while also reducing energy
- benefits include: resilience, simplicity, ease of implementation
- Yorkville-Bristol Sanitary District is the first full-scale reference in North America

**contact us for more information**



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## Q&A



A yellow crane is positioned on a concrete platform at a wastewater treatment plant under construction. The crane's boom extends upwards, and a cable is visible. In the background, there are several large rectangular concrete basins with metal walkways and railings. The site is surrounded by trees and a clear blue sky.

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