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

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How to Participate Today

• Audio Modes
  • Listen using Mic & Speakers
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Submit your questions using the Questions pane.

• A recording will be available for replay shortly after this webcast.
look who’s talking

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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

Highest efficiency of oxygen transfer by diffusion of O$_2$ into a biofilm
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

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

<table>
<thead>
<tr>
<th>aeration efficiency</th>
<th>kg-O₂/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>surface aeration</td>
<td>0.5 to 1.5</td>
</tr>
<tr>
<td>fine bubble aeration</td>
<td>1 to 2</td>
</tr>
<tr>
<td>ZeeLung</td>
<td>≥ 6</td>
</tr>
</tbody>
</table>

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
treatment challenges that ZeeLung solves

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

technology innovation through collaboration

- 20 MLD of full-scale installed capacity
- >25 technology demonstrations
- >10 research partnerships
- 21 patents issued
Yorkville-Bristol Sanitary District project

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

Activated Sludge Operation – Prior 2017

- 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
**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

**Zeelung at YBSD**

- SND in the Zeelung zone reduces the nitrate loading to anaerobic zone which improves enhanced biological phosphorus removal (EPBR) 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
performance results

Dwight

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.
Biofilm oxygen demand reactive to influent ammonia concentration within 2 weeks of start-up.
ZeeLung performance at full-scale is consistent with demonstration experience.

Comparing Performance

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

Comparing Performance ... continued

O’Brien data adopted from Kunetz et al., 2016
Microbial Analysis

**Sample Source**
- March 2018: ZeeLung cord
- April 2018: ZeeLung cord

**Sampling Method**
- qPCR
- RT-qPCR

**Quantification Method**
- qPCR
- RT-qPCR

**Total Nitrifier Population**
- March 2018: 40.5% ± 12.2%
- April 2018: 29.5% ± 23.5%

- Typical nitrifier population in MLSS is 6-8%.
- ZeeLung biofilm is dominated by nitrifiers due to the counter-diffusion of O₂ in the biofilm.

**Abundance of nitrifiers on the ZeeLung when compared to MLSS**

Q&A

- Jeff
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

Q&A