Minimally Invasive Nutrient Removal

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Minimally Invasive Surgery allows your surgeon to use technologies that limit the size and number of cuts, or incisions that they will need to make.

http://www.healthline.com

Laparoscopy is a surgical procedure in which fiber-optic instrument is inserted through the abdomen wall to view the organs in the abdomen or to permit a surgical procedure.

Oxford Dictionary

MABR is a “Membrane Aerated Biofilm Reactor” technology
ZeeLung MABR cassettes are installed in the CAS bioreactor tanks

increased biomass inventory in existing volume enables nutrient removal & capacity expansion
ZeeLung is not...

a filter

a fine bubble diffuser
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.
highest efficiency of oxygen transfer by diffusion of O₂ into a biofilm
ZeeLung cord

Cord construction ensures product robustness.
ZeeLung product
enabling 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
MABR performance indicators

Oxygen Transfer Efficiency (OTE):
- % of O₂ in blower air that is delivered to the biofilm
- **OTE 30-40% compared to 10-12% for Fine Bubble**

Oxygen Transfer Rate (OTR):
- Calculated from OTE and airflow
- **Typically 8-12 g/m²/d**

Nitrification Rate (NR):
- NH₄ removed per unit surface area biofilm
- **NR = 1.5-3 compared to NR ≈ 0.5 g/m²/d for IFAS**
ZeeLung saves energy

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

Aeration efficiency

<table>
<thead>
<tr>
<th>Method</th>
<th>kg-O₂/kWh</th>
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<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>
a simple solution

- installed in existing tanks
- fast deployment
- no impact on hydraulic gradeline
MABR is interesting but . . . Is it OK?

OR

WOW! MABR is AWESOME!
### Yorkville-Bristol Sanitary District, USA

<table>
<thead>
<tr>
<th>Customer Challenge</th>
<th>ZeeLung Solution</th>
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<tbody>
<tr>
<td>○ existing CAS plant</td>
<td>○ CAS upgrade</td>
</tr>
<tr>
<td>○ requires <strong>upgrade</strong> to treat more load (PE + industry) &amp; meet new TP limit</td>
<td>○ ZeeLung cassettes installed in existing basins</td>
</tr>
<tr>
<td>○ footprint constrained… no space for new tanks</td>
<td>○ 45% increase in capacity</td>
</tr>
<tr>
<td>○ time constrained… new TP limit pending</td>
<td>○ creation of anaerobic zone for bio-P</td>
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### Value Proposition

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<table>
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<tbody>
<tr>
<td>![Dollar Sign] $ 75% capex savings vs. CAS</td>
<td>![Clock] fast implementation</td>
</tr>
<tr>
<td>![Flashlight] 0% increase in energy</td>
<td></td>
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**ZeeLung Solution**

- CAS upgrade
- ZeeLung cassettes installed in existing basins
- 45% increase in capacity
- Creation of anaerobic zone for bio-P

**Value Proposition**

- $75% capex savings vs. CAS
- fast implementation
- 0% increase in energy

**Diagram**

- Bar chart showing total phosphorous (mg/L) for influent and effluent with a significant reduction in effluent phosphorous levels.

**capacity** 3.62
**MGD**
**Commissioned** 2018
an innovative & sustainable solution to augment wastewater plant performance

simple solution
installed in existing tanks, no civil works, fast implementation

process intensification
up to 50% more treatment capacity in existing tank volumes

process resilience
improved resilience to upset conditions

energy savings
up to 50% less energy than IFAS

resilient, simple & sustainable wastewater process intensification
Thank You for Making a Difference!

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