ENGINEERED WETLANDS FOR WASTEWATER TREATMENT

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Valisneria spiralis

Imaging $O_2$ Dynamic

Planar $O_2$ optode

Han et al. 20016
Wetland “Macrofeatures”

- Vegetation
- Hydrosoil
- Hydroperiod
Engineered Wetlands

- Treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality

- Used for decades for industrial and municipal applications

- Economically viable, socially acceptable, and environmentally sustainable
Benefits

- Effective wastewater treatment
  - Achieves low effluent limits, mitigates toxicity, treats multiple constituents
- Low operation and maintenance
- Reasonable construction costs
- Support of regulatory community
- Sustainable, green technology
Drivers

- NPDES or POTW limits
  - Excursions, limit changes, toxicity issues

- Risk management
  - Water quality and biological impacts, litigation

- Sustainability programs

- Cost
Applications

- Pretreatment of water supplies
- Stormwater runoff
- Wastewater polishing (in conjunction with other treatment processes)
- Treat wastewater for recycle, reuse or irrigation
- Pretreatment for discharge to municipal sewer system
Examples of Constituents

- 5-day BOD, COD
- Solids
- Nutrients - nitrogen, phosphorous
- Organics (e.g., petroleum hydrocarbons)
- Metals
- Toxicity
Limitations

- Water temperature
- Plant toxicity – e.g., salts, pH
- Land availability
How much land is needed?

Factors that influence treatment area:

- Target constituents
- Treatment objectives
- Processes needed to decrease or remove target constituents
- Maximum and minimum flows
- Terrain
Operation and Maintenance

- Operation and maintenance manuals
- Start-up training
- Monitor plant health, maturation
- Invasive species control
- Potential pest species
- Monitor water levels
- Ground cover maintenance
- Erosion control
Feasibility Analysis

- What are the treatment objectives?
- What is the timeline?
- What are the operational limitations?
  - Size, cost, regulatory constraints
- What are the available technical resources?
Process Design Approach

![Diagram of Eh-pH diagram with Cu-S-O-H system and atmospheric, water, and sediment phases illustrating Hg and CO₂ cycles.]
Holy City Brewing - Pilot Study

- Proof of concept
- Reduce BOD and solids load to municipal sewer in a cost-effective, low-maintenance, sustainable manner
- Consider for future expansion (currently 6,500 bbls/yr)
- Team with College of Charleston
Brewery Wastewater

- Clean in place (acid and caustic), rinsing and washing, floor drains, kitchen waste
- 4,300 gallons per day
## Wetland Influent Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
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<tbody>
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<td>TSS (mg/L)</td>
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<td>pH (s.u.)</td>
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Results - TSS

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
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Results - pH

![Graph showing pH measurements over time for Inflow and Outflow with dates from March 10, 2017, to May 12, 2017.](image)
Results - BOD

- Inflow
- Outflow

5-day BOD (mg/L)

- 3/10/2017
- 3/17/2017
- 3/24/2017
- 3/31/2017
- 4/7/2017
- 4/14/2017
- 4/21/2017
- 4/28/2017
- 5/5/2017
- 5/12/2017
Conclusions

- Total suspended solids decreased by approximately 80%
- Average pH increased from about 3.7 to 5 and stabilized
- BOD was not significantly decreased
- Investigating pre-treatment options for BOD
Acknowledgements & Thanks

- All at Holy City Brewing
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- South Carolina Department of Health & Environmental Control
- SynTerra Corporation
Information

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