Innovation in Treatment of Food Processing Wastewater

Karen Mancl, PhD
Professor Food, Agricultural & Biological Engineering, OSU

Wastewater Treatment

- Established technologies
- Domestic wastewater

Discharge to City Sewer?

Domestic Sewage

Food Processing Wastewater
Discharge to City Sewer?

Different from sewage
• 5 times stronger
• 100 times more grease

Food Processing Wastewater

Must change the wastewater
• Expensive
• Not very effective

Change treatment technology?
Change the treatment technology

Sand Bioreactor System
- Effective
- Low-cost

Designed to treat food processing wastewater

Whitewater Processing

- Kopp Family Business
  - 4th generation
  - 110 employees
  - 7000 turkeys per day

Whitewater Processing

- Kopp Family Business
  - 4th generation
  - 110 employees
  - 7000 turkeys per day

- Contacted OSU in 2000

Ohio EPA orders – Abandon old ponds

Discharging Pipe → Storage Pond → Lagoon
Options

- Connect to city
- City of Harrison – 10,000 people

Differences

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Domestic wastewater</th>
<th>Slaughterhouse wastewater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic matter (BOD₅)</td>
<td>200</td>
<td>800</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>150</td>
<td>600</td>
</tr>
<tr>
<td>Ammonia</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Fat, oil &amp; grease</td>
<td>2</td>
<td>200</td>
</tr>
</tbody>
</table>

Options

- Connect to city
- City of Harrison – 10,000 people
- 20 year cost $12.5 million

Why so expensive?

- City uses a mechanical, aeration plant
- Wastewater has too much
  - Fat
  - BOD₅
Mechanical Treatment

Why my lab?

- Innovation in wastewater treatment
- Food, Agricultural & Biological Engineering
  - Small flows
  - Agricultural wastewaters

Industry open to new options

<table>
<thead>
<tr>
<th>Lawsuit</th>
<th>Close</th>
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<tbody>
<tr>
<td><img src="image1" alt="Lawsuit" /></td>
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Regulators open to new options

<table>
<thead>
<tr>
<th>Protect environment</th>
<th>Retain Jobs</th>
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<tr>
<td><img src="image3" alt="Protect" /></td>
<td><img src="image4" alt="Retain" /></td>
</tr>
</tbody>
</table>
Develop & build
full-scale system

Dr. Karen Mancl
Professor Food, Agricultural & Biological Engineering

Ryan Kopp
Owner, Turkey Slaughterhouse

Before & After

Microbial Biofilms
Biofilm

Sand Treatment

- Microorganisms
  - Organic matter & ammonia is their food

Sand Treatment

- Create ideal environment for microorganisms

Sand Treatment

- Create ideal environment for microorganisms
  - Surface to attach to
  - Air
  - Water
  - Food

Waste water

Organic matter

CO₂
Before & After

Since 2012 – full-scale system meets all regulatory discharge standards

Fat, Oil and Grease Removal

<table>
<thead>
<tr>
<th></th>
<th>Influent</th>
<th>Effluent</th>
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<tbody>
<tr>
<td></td>
<td>FOG</td>
<td>FOG</td>
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<tr>
<td>Sept. 6, 2012</td>
<td>212</td>
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<td>Oct. 30, 2012</td>
<td>139</td>
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<tr>
<td>Nov. 19, 2012</td>
<td>189</td>
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<tr>
<td>Dec. 19, 2012</td>
<td>374</td>
<td>Not detected</td>
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<tr>
<td>Jan. 9, 2013</td>
<td>80.8</td>
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<tr>
<td>Feb. 13, 2013</td>
<td>168</td>
<td>Not detected</td>
</tr>
<tr>
<td>Feb. 27, 2013</td>
<td>273</td>
<td>Not detected</td>
</tr>
<tr>
<td>Mar. 27, 2013</td>
<td>42.4</td>
<td>Not detected</td>
</tr>
</tbody>
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Options

- City of Harrison
  - Annex
  - Sewer extension
  - Pretreatment
  - Surcharge
- Decentralized
  - Sand bioreactor
  - Onsite construction
  - Discharge permit

Costs

Connect to City

- $12.5 million
## Costs

<table>
<thead>
<tr>
<th>Connect to City</th>
<th>New System</th>
</tr>
</thead>
<tbody>
<tr>
<td>• $12.5 million</td>
<td>• $2.6 million</td>
</tr>
</tbody>
</table>

- [Image](#)

<table>
<thead>
<tr>
<th>Connect to City</th>
<th>New System</th>
</tr>
</thead>
<tbody>
<tr>
<td>• $10.56/1000 gal</td>
<td>• $3.90/1000 gal</td>
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<tr>
<td>Plus pretreatment</td>
<td>No pretreatment costs</td>
</tr>
</tbody>
</table>

- [Image](#)

## Why costs so low?

<table>
<thead>
<tr>
<th>Simple to build</th>
<th>Easy to operate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Low electricity</td>
</tr>
<tr>
<td></td>
<td>• No sludge</td>
</tr>
<tr>
<td></td>
<td>• 1 full-time operator</td>
</tr>
</tbody>
</table>

- [Image](#)

## Liners with underdrain

- [Image](#)
**Media**

- Layers of sand, coarse sand & pea gravel

**Construction**

- Easy
- Local force labor
- Purchased construction equipment
- Local aggregate company

Restaurants

Food processors

Resorts
Conclusions

- Sand Bioreactors
  - Best option for food processing wastewater
  - Local jobs
  - Saved money
  - Protects stream

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