The Practice of Co-digestion of Organic Wastes with Wastewater Solids

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Water Environment Research Foundation

Digestion of Food Discards: Panel
Food Recovery Summit
November 18, 2015
Water Environment Research Foundation

• Since 1989, WERF is America’s leading not-for-profit 501(c)(3) organization dedicated to research on wastewater, water quality, biosolids and stormwater.

• Conducted 400 research projects, valued at more than $130 million. The results of that research are enormous.
What is Domestic Wastewater?

Quantity of waste discharged per capita in US
(taken from Metcalf & Eddy, 5\textsuperscript{th} Edition page 216)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Typical w/o food waste disposers lb/capita-d</th>
<th>Typical with food waste disposers lb/capita-d</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD\textsubscript{5}</td>
<td>0.15</td>
<td>0.20</td>
</tr>
<tr>
<td>COD</td>
<td>Represents Carbon</td>
<td></td>
</tr>
<tr>
<td>TSS</td>
<td>0.15</td>
<td>0.19</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>0.062</td>
<td>0.070</td>
</tr>
<tr>
<td>TKN as N</td>
<td>0.029</td>
<td>0.031</td>
</tr>
<tr>
<td>Total P as P</td>
<td>0.0046</td>
<td>0.0048</td>
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Values on a dry weight basis
Anaerobic Digestion

• Anaerobic digestion is a microbial process that converts organic matter into methane and carbon dioxide in the absence of oxygen

• Co-digestion (digestion of wastewater sludge with supplemental organic waste)
What goes on at a Wastewater Recovery Plant?

Wastewater Influent

- Wastewater Screening
- Grit
- Primary Clarification
- Aeration
- Secondary Clarification
- Disinfection

- Treated Effluent
- Reclaimed Water
- Receiving Stream

Wastewater Sludge

- Thickening
- WAS
- Thickened WAS

Organic Waste

- Screening
- Anaerobic Digestion
- Dewatering
- Biogas
- Digested Biosolids

Organic Waste Receiving Characteristic

- FOG ~ 10,000 kCal/kg
- Food Waste ~ 4,400 kCal/kg
- WRRF Sludge ~ 5,500 kCal/kg

Anaerobic Digestion Volatile Solids Reduction

- FOG ~ 100%
- Food Waste ~ 80%
- WRRF Sludge ~ 55%

COLLABORATION. INNOVATION. RESULTS.
2% of electricity consumed in the U.S. annually is for water and wastewater conveyance and treatment.

Source: EPRI 2013; WERF 2014

- Aeration 60%
- Wastewater Pumping 12%
- Lighting and Buildings 6%
- Chlorination 1%
- Belt Press 3%
- Anaerobic Digestion 11%
- Gravity Thickening 1%
- Grit 1%
- Screens 1%
- Clarifiers 3%
- Return Sludge Pumping 1%
Why use Anaerobic Digesters at Wastewater Facilities?

Original Use
- Reduce the amount of solid residuals
- Reduce the pathogens
- Stabilize the solids

New Paradigm
- Produce biogas for energy recovery

- 66% of domestic wastewater in the USA is treated at WRRFs at or greater than 10 mgd
- Estimated 15% of the wastewater nationwide is treated at WRRFS with anaerobic digestion
Water Resource Recovery Facilities in the United States with Anaerobic Digesters

2014 data
### Why are Wastewater Managers, Operators and Engineers looking at Co-digestion?

<table>
<thead>
<tr>
<th>Model Facility for Energy Recovery</th>
<th>Net electricity production (as % of energy consumption)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic</strong> AS treatment with enhanced primary, thermal process, FOG and food waste co-digestion, AD, CHP</td>
<td>139%</td>
</tr>
<tr>
<td>Nitrification with enhanced primary, thermal hydrolysis, FOG and food waste co-digestion, AD, CHP, sidestream trmt.</td>
<td>110%</td>
</tr>
<tr>
<td>BNR with enhanced primary, 1\textsuperscript{o} sludge fermentation, thermal hydrolysis FOG and food waste co-digestion, AD, CHP</td>
<td>61%</td>
</tr>
<tr>
<td><strong>Enhanced</strong> NR with enhanced primary, 1\textsuperscript{o} sludge fermentation, thermal hydrolysis, FOG and food waste co-digestion, AD, CHP</td>
<td>49%</td>
</tr>
</tbody>
</table>

Energy Flow Diagram Comparison

Without Co-digestion

With Co-digestion
Beneficial Use of Biogas

• 85% of WRRFs with anaerobic digestion use their biogas in some manner (WEF, 2012)
Sustainable Food Waste Evaluation

- Compared food waste management options
- Co-digestion using food waste disposers and the sewers had the lowest life cycle cost
- Trucking food waste to a WRRF for Co-digestion was the most energy efficient and had the lowest CO₂ equivalent emissions
**Food Waste Compatibility**

- Deficient
- Minimal
- High (85% VSR)
- > 20%
- Carbon source

**WRREF Sludge**

- Ample
- Ample
- Relatively Low (55% VSR)
- Thicken to 5%
- Ammonia toxicity risk

**Digestion**

- Micro-nutrients
- Buffer capacity
- Digestibility (VS Reduction)
- % Solids
- Carbon: Nitrogen
Survey Results:
High Strength Organic Wastes (HSWs) that are Co-digested

Average amount – 20 MG/year
Survey Results:

Pretreatment performed at the WRRF site

- Grinder: 50%
- Pump: 60%
- Screening: 60%
- Rock Trap: 50%
- Dewatering: 40%
- Flow Equalization: 45%
- Heating: 35%
- Other: 5%
## Co-digestion with Wastewater Solids

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Co-digestion compatibility of food waste with WRRF sludge</td>
<td>Innovative practice not recognized when the NPDES program developed 40 years ago</td>
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<tr>
<td>Sidestream from co-digestion is treated before permitted discharge</td>
<td>Requires collaboration among multiple agencies</td>
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<tr>
<td>Produce more biogas – renewable energy</td>
<td>Potential for additional odor</td>
</tr>
<tr>
<td>Receive tipping revenue</td>
<td>Truck traffic</td>
</tr>
<tr>
<td>Reduce energy costs and CO$_2$ footprint</td>
<td>Increased solids handling costs</td>
</tr>
<tr>
<td>Improved digester performance</td>
<td>Additional capital and O&amp;M expenses</td>
</tr>
<tr>
<td>Extend landfill life</td>
<td>Potential digester upsets</td>
</tr>
<tr>
<td>Use existing assets (digesters)</td>
<td>Required organic waste preparation</td>
</tr>
<tr>
<td>Provide sustainable organic waste management option</td>
<td>Impact on wastewater treatment from sidestream</td>
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</table>
Co-Digestion Leaders – Victor Valley California

Eliminated the need to purchase natural gas, saving VVWRA $40,000 each month—sufficient to achieve a payback of 2.7 years.
Co-Digestion Leader – Des Moines, IA

20 year track record in co-digestion

Hauled Waste Receiving Station
Co-Digestion Leader – Ithaca, New York

25 year history with co-digestion

New Food Waste Receiving Station

Anaerobic Digester

Capstone Engines for CHP
Thank You!

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