Anaerobic Digestion of High Solids Organic Material

2014 Illinois Recycling and Resource Management Conference and Trade Show
June 2014

John McDowell, Sales Engineer – Biogas Solutions
Agenda

Drivers for Organics Diversion
Extracting Value of Organic Waste using Anaerobic Digestion
Considerations for a Successful Project & Profiles
## Eisenmann USA

- **Located in Crystal Lake**, Greater Chicago Area
- **Over 37 Years** in the US
- ~ **80 employees** (3700 globally)
- **Over 90** biogas installations worldwide
- **Over 1000** industrial installations in the US
- **Sales, Engineering, Design and Services**

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![Eisenmann USA Building](image)
Drivers for Organic Diversion
Private Industry – Waste Reduction Goals

- Agriculture
- Food production
- Restaurants
- Consumer goods
## Public Policy Leaders

### States
- Connecticut – 2011 (First State)
- Vermont – 2012
- Massachusetts – 2013

### Cities
- New York City – Dec. 2013

*Several other states and cities are exploring similar legislation and/or have reduction goals in place.*
The Future of Landfills

Environmental and Ecological Considerations

Increasing Costs

Changes in Social Perception
Current State of Organics Recovery

Figure 5. Total MSW Generation (by material), 2012
251 Million Tons (before recycling)

- Yard trimmings: 13.5%
- Food waste: 14.5%
- Other: 3.4%
- Wood: 6.3%
- Rubber, leather & textiles: 8.7%
- Plastics: 12.7%
- Metals: 8.9%
- Glass: 4.6%
- Paper & paperboard: 27.4%

Figure 6. Total MSW Recovery (by material), 2012
87 Million Tons

- Yard trimmings: 22.6%
- Paper & paperboard: 51.2%
- Food waste: 2.0%
- Wood: 2.8%
- Other: 5.7%
- Glass: 3.7%
- Metals: 8.8%
- Plastics: 3.2%

Source: EPA
Waste Audits

Conducting a waste audit or evaluation

Sources: MIT and Tim Horton
Food Recovery Hierarchy

Source: EPA

Food Recovery Hierarchy
www.epa.gov/foodscrap

Source Reduction
Reduce the volume of surplus food generated

Feed Hungry People
Donate extra food to food banks, soup kitchens and shelters

Feed Animals
Divert food scraps to animal feed

Industrial Uses
Provide waste oils for rendering and fuel conversion and food scraps for digestion to recover energy

Composting
Create a nutrient-rich soil amendment

Landfill/Incineration
Last resort to disposal

Reduce & Repurpose

After Collection
## Extracting Value from Organic Waste

<table>
<thead>
<tr>
<th></th>
<th>Landfill with Gas Collection</th>
<th>Composting</th>
<th>Anaerobic Digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions Reduction</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Energy Generation</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Nutrient Recovery</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Cost of Disposal</td>
<td>Lower</td>
<td>Middle</td>
<td>Higher</td>
</tr>
</tbody>
</table>
Extracting Value from Organic Waste

with Anaerobic Digestion
Anaerobic Digestion Process

Organic material is delivered to the digester system

Organic material is broken down in a digester

Some biogas can be used to heat the digester

Raw biogas is processed

Processed biogas is distributed and used

Liquids and solids may be separated.

Digest material is processed and distributed

Full Graphic: http://americanbiogascouncil.org/pdf/adOverview.pdf
## Anaerobic Digestion Technology Overview

<table>
<thead>
<tr>
<th></th>
<th>HORIZONTAL MIXED PLUG FLOW</th>
<th>DRY FERMENTATION</th>
<th>COMPLETELY STIRRED TANK REACTOR</th>
<th>VERTICAL PUMPED PLUG FLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solids Content in</strong></td>
<td>&lt; 45% Solids (pumpable and</td>
<td>25-70% Solids</td>
<td>&lt;15% Solids (pumpable)</td>
<td>&lt;45% Solids (pumpable and</td>
</tr>
<tr>
<td><strong>Digester</strong></td>
<td>stackable)</td>
<td>(stackable)</td>
<td></td>
<td>stackable)</td>
</tr>
<tr>
<td><strong>Digestion Process</strong></td>
<td>Continuous</td>
<td>Batch</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
<tr>
<td><strong>Digester Loading</strong></td>
<td>Automated</td>
<td>Manual (Front</td>
<td>Automated</td>
<td>Automated</td>
</tr>
<tr>
<td>and Unloading</td>
<td></td>
<td>End Loader)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Digester Mixing</strong></td>
<td>Entire Vessel</td>
<td>Static – no</td>
<td>Localized Mixers to Stir Vessel</td>
<td>Pump Circulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Footprint</strong></td>
<td>Smaller</td>
<td>Larger</td>
<td>Larger</td>
<td>Smaller</td>
</tr>
</tbody>
</table>
High Solids Flow Schematic

Biowaste AD System 3D-Model
<table>
<thead>
<tr>
<th>Substrate Conditioning Typical Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rough Grind/Shredding</strong> – Open bags, reduce oversized items</td>
</tr>
<tr>
<td><strong>Screening/Separation</strong> – Contaminate removal</td>
</tr>
<tr>
<td><strong>Fine Grind</strong> – Reduce particle size for more complete digestion</td>
</tr>
</tbody>
</table>
Substrate Feed System - Solids

Provides buffer storage of conditioned, high solids organic waste

- Suited for stackable and bulk materials
Substrate Feed System - Liquid

Receiving pit and/or tanks for liquid organic materials
Receives and provides buffer storage

- Suited for all pumpable organic material
Maximizing Biogas Production

1. Outer wall
2. Insulation
3. Concrete inner wall
4. Heating elements
5. Exterior gas holder membrane
6. Gas storage membrane
7. Gas membrane support webbing
8. Horizontal agitator
## Output – Biogas and Digestate

<table>
<thead>
<tr>
<th>Combined Heat and Power Unit (CHP)</th>
<th>Biogas Upgrading Unit</th>
<th>Digestate</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Electricity: on-site or fed into utility or micro grid</td>
<td>- Fed into utility pipeline system (RNG)</td>
<td>- The nutrient-rich solid and liquid digestate can be a valuable co-product</td>
</tr>
<tr>
<td>- Thermal energy: heat digestion process or industrial processes</td>
<td>- Utilization as vehicle fuel (CNG or LNG)</td>
<td>- Soil Amendment, Fertilizer, Composting</td>
</tr>
</tbody>
</table>

![Combined Heat and Power Unit (CHP)](image1)

![Biogas Upgrading Unit](image2)

![Digestate](image3)
Considerations for a Successful Project
Considerations for a Successful Project

- Location and permits
- Feedstock volume, availability and quality
- Digestate and biogas utilization
- Build your team for success
- Financing
The Plant Project Profile

- Closed Loop Facility – Organics to Heat and Power
The Plant Anaerobic Digestion Project

Chicago, Illinois – Phase 1

The Plant
Vertical Faming, Aquaponics, Shared Kitchen Rentals, Microbrewery
125 Green Collar Jobs in the “Back of the Yards”

Feedstocks
Food Waste and Brewery Waste

Throughput
14 Tons per Day
~ 5,000 Tons per Year
(10,000 Tons per Year after Phase 2)

Power and Heat
190 kWe genset
The Plant Flow Diagram
### The Plant Project Benefits

- Sustainable Urban Agriculture in Food Desert
- Net Zero Energy Facility
- Reduction of greenhouse gas emissions
- Creation of renewable energy
- Use of digestate rather than fossil fuel based fertilizer
CR&R Biogas Case Study

- Organic Waste to Vehicle Fuel
CR&R Anaerobic Digestion Project

Perris, California – Phase 1

CR&R Environmental Services
~50 Municipal Contracts
> 2.5 Million Customers

**Feedstocks**
High Solid Yard and Food Waste

**Throughput**
229 Tons per Day
~ 80,000 Tons per Year
(Over 300,000 Tons per Year in 2020)

**Biogas / CNG Production**
~ 1,000,000 Diesel Gallon Equivalent (DGE) per Year
CR&R Flow Diagram

- CR&R Preprocessing (Yard and Food Waste)
- MAIN DIGESTERS
- SEPARATOR
- POST DIGESTER
- BIOGAS UPGRADED UNIT

- Biogas
- Compressed Biomethane
- CR&R Truck Fleet

- Solid Digestate
- Liquid Digestate
- Soil Amendment / Fertilizer
CR&R Project Benefits

- Diverting green waste to biogas plant reduces emissions of green house gases
- CNG to fuel fleet of collection vehicles
- Digestate will be used as soil amendment or composting

“After a worldwide search, Eisenmann’s anaerobic digestion system stood out as the only technology that was able to provide the highest possible conversion rates for the broadest range of feedstocks.”

Mike Silva, CR&R Organics Processing Project Leader
Contact

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Stay in touch with us:
Promoting the Use of Biogas

- 208 Members from the U.S., Germany, Italy, Canada and the UK
- All Industry Sectors Represented

**Key Industry Goals:**

- Promote biogas markets, technologies and infrastructure
- Achieve policy parity
- Promote as a best practice for environmental stewardship and greenhouse gas reduction

www.americanbiogascouncil.org
Changing the Biogas Industry through:

- Legislative and Regulatory Affairs:
  - **Federal:**
    - Favorable language in **Farm Bill**
    - Introduction of **Biogas Investment Tax Credit** (Rep. Kind and Rep Lewis)
  - **States:** 8 separate organics recycling legislations

- Sharing Expertise:
  - Specialized Working Groups

- Marketing and Education:
  - Briefings, presentations, and webinars for customers, policy makers, and the general public

- Member Exposure
  - Speaking opportunities in ABC workshops, webinars

- Large Industry Network – 6,000+ member company contacts
  - Entire supply chain of production, processing and use

**Join Today!**

Contact Josh Lieberman at [jlieberman@ttcorp.com](mailto:jlieberman@ttcorp.com) or 202-640-6595 x 322

[www.americanbiogascouncil.org](http://www.americanbiogascouncil.org)
Dedicated to maximizing the production and use of biogas from organic waste

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