



Overview Of Anaerobic Digestion and Digesters

A Different View



Is Waste Really A Waste
Or Is It Perhaps A Resource



Waste vs. Biomass – Resource?

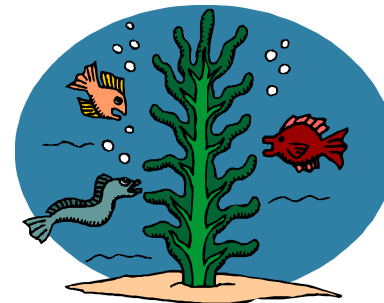


- Simple Definitions-
 - Refuse waste - garbage, trash
 - Biomass / Organic Waste – organic material that comes from plants and animals
 - Resource - available supply that can be drawn upon when needed



Common Organic Wastes

- Manure
- Food Scraps
- Food Process Side Streams
- Yard/Landscape By-products
- Saw Mill Side Streams
- Algae
- Grasses



Simple Process Definition



- Anaerobic Digestion - natural process that converts biomass to energy under oxygen free conditions; bacteria the most important factor; net energy gain and useful byproducts

Anaerobic Digestion



- There are three anaerobic digester operational temperature ranges:
 - Psychrophilic – 68 degrees Fahrenheit
 - Mesophilic – 95 to 105 degrees Fahrenheit (PSRP-Class “B” Solids-(USEPA Title 40 Part 503))
 - Thermophilic – 125 to 140 degrees Fahrenheit (PFRP-Class “A” Solids-(USEPA Title 40 Part 503))

Anaerobic Digestion



- Wet (often Mesophilic): Main component in the raw substrate is water; incoming solids usually less than 15 %; residence time usually 60-95 days
- Dry (often Thermophilic): Main component in the raw substrate is still water; incoming solids greater than 20% up to 45 %, residence time from 9-45 days
- Residence time = input material, temperature and process system

Anaerobic Digestion



- Types (Wet):
 - Plug Flow – Low Rate
 - Complete Mix – Low Rate
 - Fixed Film – High Rate (soluble)
 - Lagoons – Low Rate
 - Contact – High Rate (Return of Solids)

Anaerobic Digestion



- Wet Type Parameters:
 - One digester tank system; about 2-3 acres site size including at least one building; project costs could be up to 4 million; heavily dependent on available organic wastes
 - Two digester tank system; about 5-6 acres site size including at least one building; project costs could be up to 5 million; heavily dependent on available organic wastes

Anaerobic Digestion



- Dry Type Parameters:
 - Batch Type: Higher end of solids range, pre-screening; one or two stages: rough estimate of 5-10 acre site to handle 35-40,000 tons per year
 - Continuous Type: Lower end of solids range, pre-screening; Single-stage high solids, multi-stage low solids; vessels can be horizontal/vertical; can be more site efficient

Anaerobic Digestion



- MSW Dry Digestion European Parameters:
- Capital Cost (Millions \$\$-2007) vs. Design Capacity (thousand MT/yr); \$12-15 million for 50 thousand metric tons/yr and \$16.5-22 million for 100 thousand metric tons/yr
- Operating Cost (2007-\$\$/MT) vs. Throughput (thousand MT/yr); \$28-133 for 50 thousand metric tons/yr and \$18-118 for 100 thousand metric tons/yr
- www.ciwmb.ca.gov/publications/organics/2008011

Anaerobic Digestion



- Byproducts: (raw substrates will affect)
 - Digester gas- methane can be as high as 70% more commonly 60%; carbon dioxide at 30% (40%) with trace elements of hydrogen sulfide, water vapor, etc.
 - Post digested material (usually a 50% solids reduction within digester); then compost or dewater = liquids (fertilizer) + solids (30%); solids can be bedding, soil amendment, dried for pellet fuel, etc.

Anaerobic Digestion



- Revenue/Energy-Digester
 - Electricity produced from the CHP(s) (up to 1.5 Megawatts)
 - Heat from the CHP(s)
 - Carbon Dioxide from the CHP(s)
 - Post digested liquids-fertilizer
 - Post digested solids-bedding, soil amendment, compost, skate boards, etc.
 - Carbon credits
 - Tipping fees



Wet Anaerobic Digestion Facility

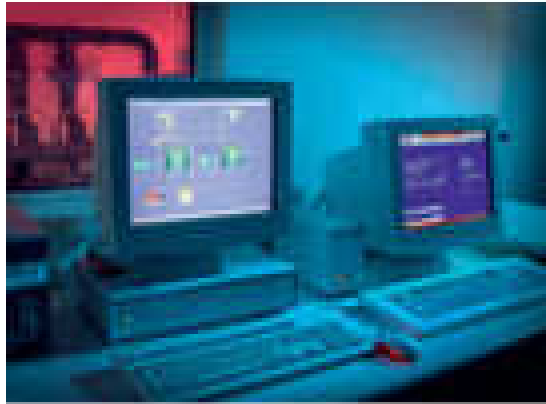


CHP installed



Example CHP unit inside building

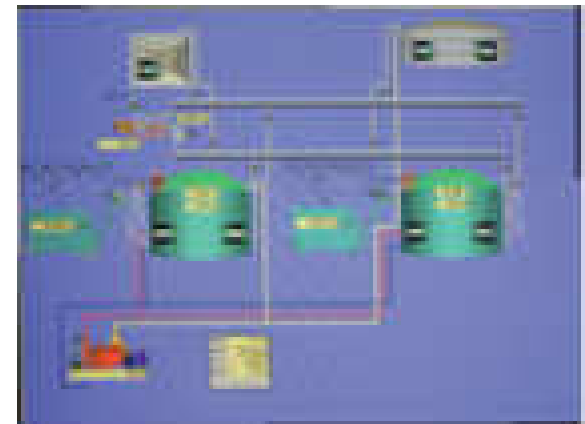
Process monitoring and controls



Remote access



Electronic controls



24hr monitoring

AIKAN Cyclus



Compost being unloaded



Compost being sorted



Fertilizer and organic matter back to Soils

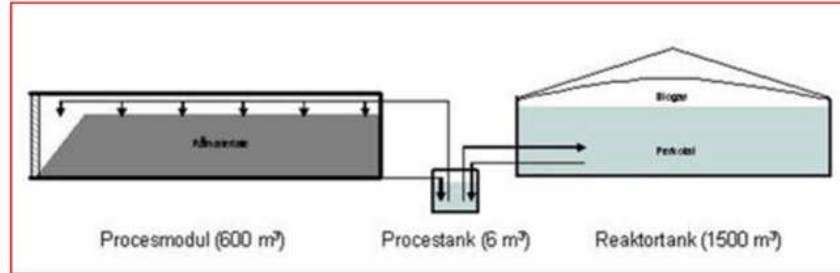
Biogas for Electricity

Or cleaned for cars

Or heating houses



Process modules and biogas reactor



AIKAN – Two phase biological treatment



Gas facilities



Raw materials being loaded



Rawmaterials of food waste and structure



Impurities being sorted off



Food waste being unloaded

From source separation to soil

**From the Aikan
plant in Norway**



Anaerobic Digestion–New York State



- About fifteen (15) operating anaerobic digesters in New York
- Most all are plug flow type
- Most all on farms-manure focus
- Most operating less than 60% efficiency
- Not designed for food wastes

Organic Food Wastes



- Generally 14-18% of municipal waste stream
- Solids at 20-45%
- Preferred fuel value: sugars, carbohydrates, proteins
- Bugs like carbon
- Water has no fuel value
- Water has to be heated

Anaerobic Digester Considerations



- Quality of input organic waste feed stocks
- Feed stock sources within reasonable radius
- Feed stock source consistency
- Economics drive digester size
- Design for energy output
- Design for output product- Class “A”

Development Considerations



- Site location: Accessibility, Environmental impacts
- Site history: Brownfield, Green
- Site infrastructure: Utilities (In/Out)
- Permitting: Federal, State, Local (6 Months)
- Six (6) months plus for construction
- Required agreements: Development, ownership, power purchase, supply sources, end products



- TomLawson@NorthEastBiogas.com
- 585-747-0268