“Wet” and “Dry” Anaerobic Digestion Technology Solutions for Processing Municipal Solid Waste

Meredith Cummings
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Viessmann Group
The Company

1917
Company foundation of the Viessmann family enterprise

11,400
Employed workforce today

$2.4
Billion US dollars Viessmann Group turnover in 2011

27
Production companies in 11 countries

74
Countries with sale activities and distribution partners

120
Branches world-wide

55
Percent of the turnover derived from export activities

Branches
Distribution partners
Viessmann Group
Comprehensive Range

Core Brand

Field of Application
- Single-family homes
- Appartment buildings
- Industry- and commercial buildings
- Local heating networks

Energy Source

Product Range

1.5 kW – 116 000 kW
Viessmann Group
Anaerobic Digestion and Gas Upgrading Specialists
**BIOFerm™ Energy Systems**  
*Anaerobic Digestion Specialist*

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BIOFerm™ Technology Overview
Managing Waste and Making Energy Across Sectors

Agricultural
Municipal
Industrial
Campuses
Digester Solutions
Systems for Varying Waste Streams and Footprints

BIOFerm™ Dry Fermentation System

“EUCOlino” Compact, Plug & Play System

“COCCUS” Wet Fermentation System

“EUCO” Hybrid Fermentation, Plug-Flow System
Waste Nothing Opportunities
Turning Organic Waste into Renewable Energy

Organic Waste → Anaerobic Digestion → Electricity → Fuel (CNG)
MSW Waste Streams
Total MSW Generation by Material (Before Recycling/Diversion)

- Paper 27.4%
- Food Waste 14.5%
- Yard Waste 13.5%
- Plastics 12.7%
- Metals 8.9%
- Rubber/Textiles 8.7%
- Wood 6.3%
- Glass 4.6%
- Other 3.4%

*2012 EPA Estimates

Photo courtesy of BioCycle.net
Overview of Wet Fermentation Systems
Wet Fermentation
“COCCUS” CSTR Reactor

- The BIOFerm™ industrial grade wet fermentation anaerobic digestion process uses organic input materials to produce biogas.
- 28 day retention time.
- Small amounts of additional water required (feedstock dependent!)
- Ideal for processing low-solids biomass like manure, spoiled silage, cheese whey and other low-solids organic waste.
- The biodigester processes feedstocks through the system with continuous stirring.
Wet Anaerobic Digestion
Liquid Waste Streams

Typical Wet AD
- Livestock Manure
- Agricultural Residues
- Food Waste
- Bio Solids
- Food Processing Waste
- Cheese/Yogurt Whey

Target TS value: 8-11%

MSW Pre-Treatment Required
- Chopping
- Removal of Metals
- Removal of Glass/Stones
- Homogenization (mixing)
Energy Requirement of Pre-Processing Equipment

Parasitic Loads

Shredding and Grinding (Med-High Energy Req.)
- Hammer Mill
- Tub Grinder
- Disc Grinder

Screening (Med-Low)
- Trommel Screen
- Star Screen
- Gravity Sorting

Magnets (Med-High)
- Metals Removal

Pre-preprocessing Energy Requirements and added Costs can make certain projects less financially attractive

Photo courtesy of biocycle.net
Wet Fermentation Digester

SULA Final Storage

Pit Digester COCCUS®

Plug Flow Digester EUCO®

Technical Container/AIO

CALIX Reception Pit
EUCO®
High Solids Digester

- Designed for input material with higher TS content (~17%)
- Liquefy (hydrolyze) the higher solid feedstock
- Large portion of biogas production occurs in EUCO®
- Pair with COCCUS® for mixtures of high solids/low solids feedstock
KB Bio Energy Digester
Wet Fermentation—Akron, OH

Feedstocks:
• Phase 1 (2007):
  – 1 COCCUS/1 EUCO 1 CHP
  – 5,000 tons/year wastewater sewage sludge
• After expansion (2013):
  – 3 COCCUS/3 EUCO
  – 3 CHP’s
  – 13,000 tons/year sludge
  – Food Waste Planned

Energy output:
• Phase 1:
  – 330 kW electric capacity
• After expansion:
  – 1.2 MW electric capacity

Financials:
• Phase 1: $7M capital investment
  – $250,000/year compost sales
• Phase 2: $32 Million
Overview of Dry Fermentation Systems
Municipal and Waste Management
Dry Fermentation System

- The BIOFerm™ industrial grade dry fermentation anaerobic digestion process uses high TS organic input (16-25% TS) materials to produce biogas
- A batch system - reloading on a 28 day cycle
- Little to no additional water required
- Material stays stationary, while bacteria (percolate) is sprayed over it to accelerate the decomposition process
- Percolate seeps through the biomass and is reused again
- The input material is reduced by up to 40% and energy is extracted in the process
The BIOFerm System – Biogas from dry fermentation

The biogas is fed into a CHP unit, which generates electricity and heat.
Municipal and Waste Management
BIOFerm™ Dry Fermentation System

1. Mixing hall with compost boxes and digesters
2. Exhaust system with biofilter
3. Gas dome
4. Substrate storage
5. Percolate storage tank
6. Composting

Additional Liquid Feedstocks can be Added to PST Tank Directly for More Biogas Production!
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Photo courtesy of BioCycle.net
Dry Fermentation Case Study
Biodigester 1 at the University of Wisconsin—Oshkosh

Waste Stream

- Food waste from local grocery stores and restaurants
- Yard waste consisting of grass clippings, leaves, brush, shrubs and tree clippings
- Post-consumer food waste from University of Wisconsin-Oshkosh cafeteria
- Animal bedding from local farmers
- Low Contamination
Dry Fermentation Case Study
Biodigester 1 at the University of Wisconsin—Oshkosh

- Installed electrical capacity: 370 kW
- Installed thermal capacity: 495 kW
- Input material: 10,000 tons/year
- No. of fermentation chambers: 4
- Length x Width x Height: 65 ft x 23 ft x 16.5 ft
- Construction start date: September 2010
- Beginning of operations: Summer 2011
Dry Fermentation Case Study

Dry Fermentation: Biodigester 1 at Oshkosh, WI

Energy Output

- UW Oshkosh’s biodigester provides up to 10% of campus electricity needs

This is equivalent to:

- Electricity for 210 homes per year
- Energy to heat 180 homes per year

Emission Reduction

- Methane displacement: 8,813 metric tons CO2 equivalent
- Electricity generation from renewables: 1,942 metric tons CO2 equivalent
Dry Fermentation Case Study
Biodigester 1 at the University of Wisconsin—Oshkosh

Financials

- $3.5 million capital investment
  - Federal government grant: $500,000
  - Focus on Energy (State of Wisconsin) $232,587
HSADF Metrics & Energy Production
Alberta, Canada

- 8-Fermentation Chambers
- 40,000+ tpy MSW waste
- Indoor Mixing/ Receiving
- 1.4 MW CHP Engine
- 12,475 MWh of electricity/yr
- 50,000 GJ/year (thermal)
Case Study: High Solids Dry Anaerobic Digestion Facility
Alberta, Canada

40,000 tonnes/yr
- Yard Waste- 10,000 tpy
- ICI Source Sep. Organics- 13,700 tpy
- Residential Food Waste- 14,400 tpy
- Horse Manure - 600 tpy
- Inerts – approx. 1,300 tpy
  - ~7%-13%

Minimal pre-processing required before entering fermenter
Waste Receiving & Pre-treatment
Techniques-Sogliano, Italy - Dry Anaerobic Digestion Facility

- Reception
- Shredding/De-bagging
- Mixing
- Digester Loading
Facility Processing
Sogliano

- **Mechanical Process**
  - Low Speed Shredder
  - Mixing by Front-end Loader
  - Trommel Screens

- **Biological Process**
  - Dry Digestion
  - Tunnel Composting
  - ASP Curing
Flexible Biogas End Usage
Pressure Swing Absorption (PSA)

Photos courteously of: INGAA, ACUA, and CNG Now
Waste to Energy/Fuel
Full Cycle Relationship

Haulers
- Changing tipping fees
- Fluctuating fuel costs
- Ownership

Anaerobic Digestion
- Waste amount
- Waste type
- Size of facility

Compressed Natural Gas
- Storage
- Fueling location
- Vehicle retrofits

Pressure Swing Adsorption
- Facility sizing
- Biogas conditioning
- Regulations

Photos courteously of CNG Now, Star News Online
At BIOFerm™ we see our role as “re-definers” of waste. We hope to provide the tools for industries to make the most of the resources within their reach—nothing is waste until you waste it.
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