Anaerobic Co-Digestion of FOG:
Pilot Demonstration at BCUA

NEW JERSEY WATER ENVIRONMENT ASSOCIATION
SPRING CONFERENCE
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Problem Statement

Air Emissions
Treated Water
Energy
Biosolids

Raw Wastewater

WWTP

Liquid & Solid Streams in WWTP

Primary Clarifier
Activated Sludge
Secondary Clarifier
Sludge Thickener
Biosolids

Biosolids Management

- Ocean Dumping (banned)
- Landfilling (cost)
- Incineration (cost, emissions, NIMBY)
- Aerobic Stabilization
- Anaerobic Digestion
- Innovative Technologies
- Etc.

WHERE IS THE ENERGY SPENT in WWTPs?

Beneficial End Use of Biogas

- Boilers → Steam
- "ICE, Turbine, or Microturbine
- Hot Water or Steam
- Fuel Cell

Waste Gas Flare
Relief to Atmosphere
Compression
Gas Treatment
High Performance Anaerobic Digesters

Biogas
Biogas
Biogas
Wastewater
Solids
Biogas

"
Biogas Production Rate for Various Substrates

Source: Basisdaten Biogas Deutschland, March 2005: Fachagentur Nachwachsende Rohstoffe e.V

What is Brown Grease?

- Fats, Oils, and Grease (FOG) that have come into contact with graywater
- Found in restaurant grease traps and interceptors
- High free fatty acid (FFA) Content: 50-100%
- Not "economically" suitable as feedstock for biodiesel

Brown Grease = Renewable Energy Potential

Anaerobic biodegradation of volatile solids (VS) yields Biogas (mixture of Methane and Carbon Dioxide and impurities)

How much Brown Grease is there?

- In 1998 NREL conducted a study funded by DOE in 30 metropolitan areas
- Metropolitan areas ranged in size from Bismarck, North Dakota (population 83,831) to Washington, DC (population 3,923,574).
- Desk Study based on NREL estimates & Census Data conducted to estimate Bergen County’s Brown Grease Generation Rate

Addition of Co-Substrates

How do you know the co-substrates will function in a digester?

- Feed the AD & cross your fingers
- Literature Research
- Laboratory Bench Scale Testing
- Computer Modeling
- Pilot Demonstration

Main causes of process perturbation leading to AD system failure

The relative time assumes that no actions have been taken to correct the original cause of the perturbation
Bench Scale Anaerobic Bioreactors

Effect of Sludge and Brown Grease Co-Digestion on Methane Production

Enhancement of methane potential as a function of amount of grease trap sludge added

Correlation between methane content in Biogas and Carbon Chain Length in Feed Stock

Theoretical FOG Biogas Production

$C_{27}H_{56}O_8 + 28 H_2O \rightarrow \text{Anaerobic Digestion} \rightarrow 40 \text{CH}_4 + 17 \text{CO}_2$

This corresponds to 70% methane & 30% Carbon Dioxide

Under STP, 1 mole of FOG produces 948 Liter of Methane. This translates to 17.2 SCF per pound of digested FOG

Luostarinen et al (2009) reported 14.7 SCF/Lb VS

Block Diagram for FOG Processing Pilot Demonstration
FOG Pre-Processing

(a) Bar rack basket filled with debris
(b) Manual cleaning
(c) Cleaned bar rack basket

FOG Receiving Pit at BCUA

Built-in Screen
Non-functional pipes & fittings

(a) Top view
(b) Internal Components

Average FOG Characteristics

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<thead>
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<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
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<td>Water Content</td>
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Pilot Study Results

- Addition of FOG as a co-substrate increases significantly biogas production.
- FOG can easily be fed as a co-substrate to the existing anaerobic digesters.
- Co-digestion of FOG results in the production of 8.2 SCF of biogas per gallon of FOG.
- Value compares very well with the 7.3 SCF biogas per gallon of FOG obtained during pilot testing at the Sacramento Municipal Utility District (SMUD) wastewater plant in California.

Environmental Benefits

- Less CO2 Emissions from shorter truck haul routes
- Renewable energy replaces energy from fossil fuels
- Less CO2 than landfilling.
- Less CO2 and energy production as compared to current use of FOG as auxiliary fuel in sludge incinerators
- Reduction of sewer blockage

Conclusions

- Increased biogas methane generation, along with energy and economic benefits;
- Receiving tipping fees for handling these materials;
- Minimizing sewer grease buildup and clogged sewers
- Reduction of GHG Emissions
QUESTIONS?