

Resource Recovery

Biogas potential in the Co-digestion
of Septage and Grease Trap
Residue



Co-generation

- The use of an alternative fuel to drive an engine/generator for the production of electricity.



Co-digestion

- The addition of a second feedstock or "substrate" to enhance biogas production in an anaerobic digester.



Types of Digesters

- Covered Lagoon
 - 34 day retention time
 - Unheated
- Plug Flow
 - 28 day retention time
 - Mesophilic; 95-100°F
- Complete Mix
 - 18 day retention time
 - Mesophilic
 - Thermophilic; 131°F



Operating principles

- Addition of specified volume of liquid waste
- Heat increases gas production; to a point
- Biogas consisting of methane, carbon dioxide and hydrogen sulfide is created
- Biogas is scrubbed of carbon and sulfur dioxide
- Biogas is burned in a boiler or engine/generator



Dairy Farms

■ Small Farms

- Blakes Landing Farms; 235 milking cows
- Covered Lagoon
- 75 Kw generator
 - 11.5 hours per day

■ Large Farms

- Cottonwood Dairy; 5,000 milking cows
- Covered lagoon
- 300 Kw generator



Dairy Farms

- Centralized Systems
 - Inland Empire Utility Agency
 - Regional Plant #5 RP-5; 9,800 milking cows from 10 dairy farms.
 - Total flow 35,000 gpd
 - 3,977 kwh/day
- Powers Chino Basin Desalter Facility to clean up groundwater.



Blakes Landing Farms

- 245 milking cows
- 1.36 mg covered lagoon digester
- 30,000 gpd flushed manure, 10,000 gpd creamery waste
- 34 day retention time
- Installation cost; \$335,000.
 - \$200,000 owner investment after grants and incentives
- Return on owners investment; 5 years



Blakes Landing Farms



Plug Flow



Complete Mix



Big Pipe Digesters

- **Complete Mix**
 - Mesophilic
- **Process Wasted Activated Sludge**
 - WAS
- **Neutralizes sludge for solid waste disposal**
 - Pathogen kill 95%
- **Biogas typically flared or used to supplement digester heating.**



City of Millbrae, CA

- 2 mgd municipal wastewater facility
- 2, .5 mg digesters
 - 27,777 gpd WAS
- 3,000 gpd FOG = 10.8% of total loading
- 76% increase in biogas production
- Providing 68% of plant energy needs
- **28% reduction in biosolids disposal**
- Tipping fee; \$0.06/gal.



City of Watsonville, CA

- 7.1 mgd municipal wastewater facility
- 2, 1.5 mg digesters
 - 83,333 gpd WAS
- 4,500 gpd FOG = 5% of total loading
- 50% increase in biogas production representing a \$129,018 increase in annual income from co-generation.
 - Approximately \$0.07 per gallon of FOG.
- \$59,473 income from tipping fees.



Redwood City, CA

- 18 mgd municipal wastewater facility
- 3, 1.5 mg digesters
 - 250,000 gpd WAS
- 3,500 gpd FOG = 1.4% of total loading
- \$100,000 increase in annual income from FOG addition in biogas co-generation
 - Approximately \$0.08 per gallon of FOG
- Tipping fee; \$0.10/gal.
 - \$25.00 dump fee



Big Pipe Driver; *Technical*

- Remove nuisance wastes from the collection system, especially if a waste is causing stoppage, odor or damage.
- Remove organic loadings and nuisance factors from headworks and liquid treatment train.
- Increase use of existing digester capacity, especially with co-digestion of wastes that are synergistic with wastewater sludge in terms of increasing the volatile solids loading rate.
- Improve knowledge of how to handle high-strength wastes.
- Provide a reliable outlet for high-strength wastes



Big Pipe Driver; *Economics*

- Develop a new revenue stream from tipping fees for highstrength wastes.
- Produce more biogas to fuel combined heat and power systems or thermal dryer systems or other beneficial uses.
- Reduce cost of operation, maintenance, and odor control in the liquid treatment train, from headworks to final clarifiers.
- Avoid or defer construction of additional liquid treatment train capacity.
- Increase the throughput rate of the solids processing train.



Big Pipe Driver; *Environmental*

- Earn carbon credits (subject to legislation in Congress).
- Reduce land application of organic wastes that contribute to methane production rather than carbon sequestration.
- Reduce emission of greenhouse gases, particularly methane, coincidental to increasing energy recovery from waste materials.



Digester feed stock	Biogas Potential m³/ton of substrate
Septage	13.1 (calculated est.)
Sewage sludge	15
Pig slurry	22
Cattle slurry	26
Chicken manure (fresh)	54
Cattle manure (fresh)	77
Sheep manure (fresh)	162
Corn silage	204
Grease trap residue	285
Wheat straw	361
Corn stalks	557
Oil seed residue	624



European data

Digester feed stock	Biogas Potential m³/ton of substrate
<i>Septage</i>	<i>13.1</i>
<i>Grease trap residue</i>	<i>285</i>



Mathematical factors

- One Cubic Meter = 256.5 gallons
- .45 Cubic Meter of biogas = 1 KW electricity
- $13.1\text{m}^3/\text{m}^3$ Septage
- $285\text{m}^3/\text{m}^3$ Grease trap residue



Example

- Hapchuk Liquid Assets Facility
 - 25,000 gallons of septage per day
 - 25,000 gallons of grease trap residue per day.



Doing the math

- 256.5 Gallons per m³
- Septage; 25,000 GPD
 - 97.4 m³ X 13.1 = 1275.5 m³ biogas
- Grease trap residue ; 25,000 GPD
 - 97.4 m³ X 285 = 27759 m³ biogas
- 1251 + 27217.5 = 29,034.5m³
- 29,034.5m³ / .45m³ = 64,521kw
- 64,521kw X \$0.06 = \$3,871.26/day



Estimated income

- $\$3,871.26/\text{day} \times 260 = \$1,006,527.60/\text{year}$
 - Approximately \$0.15 per gallon of FOG
- Hard to believe...!?
- So let's use the numbers from the municipal data;
 - \$0.07 per gallon FOG X 25,000gpd =

$$\$1,750/\text{day} \times 260 \text{ days} = \$455,000.00$$



Investment considerations

- Blakes Landing Farms; 5 year ROI
- Proposed Canadian project; 7 year ROI
 - Does not consider 28% reduction in biosolids disposal fees.
- Escalating tipping fees.
- Scale of economy?
- Federal incentives as “green” energy producer?
 - Carbon credits



Current economics

- United States average price per kw generated, reverse metering/net energy producer.
 - \$0.06 to \$0.08 per kwh
- Puerto Rico average price per kw generated.
 - \$0.25 per kwh
- Europe average price per kw generated.
 - \$0.35 per kwh



Future economics

- Carbon tax
 - Expected to drive energy production value up four fold.
 - US could reach \$0.24 in near future
- Transportation fuel cost will go up.
- Tipping fees continue to rise.
 - Septage
 - Biosolids



Big Pipe economics

- Municipal sewage treatment facilities are increasing fees, efficiency and profits from high strength waste, specifically, FOG from grease trap residue.



Big Pipe attitude

- Septic haulers don't have the expertise to run these types of operations.
 - But Dairy Farmers do.
- They “throw a little lime and polymer at it and haul it to the dumps”.
- In other words, they don't want the competition... again.



Future of Decentralized

- Pass the increased costs along?
- Increase efficiency and profits, keep costs down.
- Prove our commitment as a viable option for wastewater management.
- Be proactive and progressive.



Where to start

- Research project
- Establish parameters for testing
- Fund pilot project
- Establish a support entity
 - Decentralized Industry Lobbyist



References

- California Energy Commission; Dairy Power Production Project, 2007
- Genivar Constructive People; Georgian Bluff, Canada septage processing project. 2008
- Water Environment Federation; Direct Addition of High Strength Waste to Municipal Wastewater Anaerobic Digesters, 2010



Questions?

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