Utilizing Anaerobic Digester Capacity to Process Source Separated Organics: Two Case Studies

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Presentation overview

- Source Separated Organics Streams
- Nashua WWTF
- Ithaca Area WWTF
- Other Communities and Viability

Digester capacity

Hydraulic Retention Time (HRT)

- Time liquid is held in the digestion process
- Volume of liquids in reactor / quantity of biosolids removed daily

Volatile Solids (VS) Loading

- Amount of volatile solids in sludge entering digester / volume of digester
- TR16 maximum VS loading rate = 120 lbs VS per day / 1,000 ft3 digester volume

Potential waste streams

- Low strength waste
  - Cheese
  - Yogurt
  - Apple juice
  - Septage
- Mixed food waste
- High strength waste
  - Oils
  - Glycerin
  - Concentrated food products

Low strength single stream liquid food wastes

Characteristics

- Consistent chemical makeup of waste
- Typically good process control by food producers – minimizes potential for digester upset
- Limited packaging/inert materials

Processing

- Mechanical mixer for storage tanks
- Receiving facility
- Increased solids hauled off-site

Mixed food waste

Characteristics

- Highly variable stream
- High probability of packaging/inert materials

Processing

- Screen for packaging
- Macerate to consistent small particle size
- Slurry to 5 -7 % solids
- Increased solids hauled off-site

Brown & yellow grease

Yellow Grease:

- Used cooking oil
- Existing market for high strength wastes – hard to obtain
- Yellow grease – biodiesel

Brown Grease:

- Animal fat, grease

Brown & yellow grease

Characteristics:

- Excellent substrate for digesters
- Dramatically increase digester gas production
- High VS proportions and digests well

Processing (Brown Grease)

- Heated and mixed storage tank
- Odor issues
- Known to cause foaming in digesters – pilot typically required
- No measurable increase in amount of solids hauled off site

Off-Spec vegetable oils and glycerol

Characteristics

- 0.5 – 1% of total digester input – significantly increases digester gas production
- 1 – 2 % - begins to impede digester gas productions and upset digester biology

Processing

- Require mixed and heated storage tank
- Odors should not be concern
- No measurable increase in amount of solids hauled off site

Required infrastructure

Liquid:

- Low strength liquid waste
- Septage
- Grease
- Glycerol

Solid:

- Mixed Food Waste

Liquid unloading station

- Transfer pump and quick disconnect station
- Low odor potential

Solids unloading

- Typically delivered in roll-off containers or dump trucks
- Dump pit or Hopper
- Large screen
- Chopper/macerator
- Dilution system to add liquid and slurry to 5-7% solids
- Need odor control

Case Studies

- Nashua WWTF
- Ithaca Area WWTF

Nashua WWTP

- 16 MGD Secondary Treatment Facility
- 1.25 MG egg-shaped digester
- Minimum HRT = 15 days for Class B biosolids
- Facility currently has 3 tanks available to store substrates (~67,000 gallon capacity) – unheated
- Economic analysis of source separated organics

Biogas production

Measurement

- Unreliable in past
- Project to install new digester gas flow meters

2012 Estimate

- 335 kW

Uses:

- Digester gas-fired boiler
- Dual fuel boiler
- Engine generator
- Flare

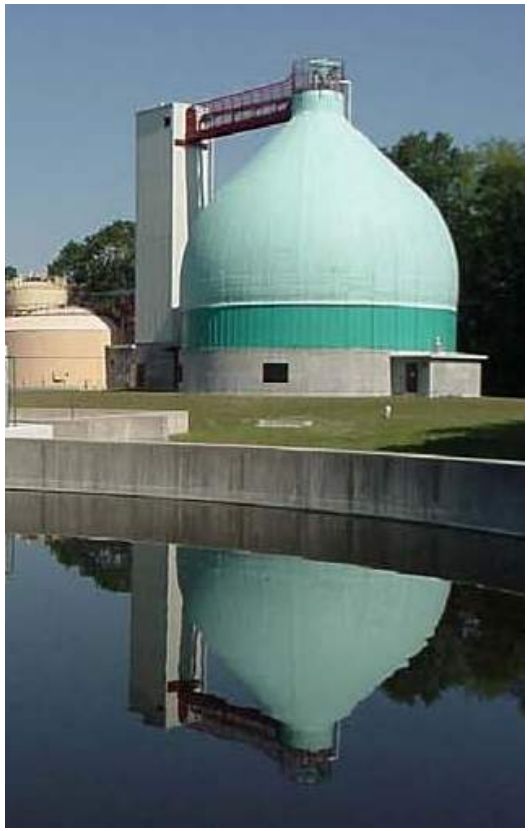
HRT capacity

- Current HRT = 17.1 days
- Factor of Safety – 1 days storage
- Excess Capacity (~ 5%)

2012 Influent Stream	Daily Quantity (gpd)
Primary Sludge (PS)	56,500
Waste Activated Sludge (WAS)	16,800
Septage	Negligible
Total	**73,300**

Volatile solids capacity

- Traditional Circular Tanks with Vertical Walls = 50% reduction
- Egg Shaped Digester = 55 – 60%
- Excess Capacity = 2,000 lb/day VS



Options

Additional Substrate	gpd	Electrical Energy (kW)
Low Strength	4,800	35 – 45
Septage (to head of plant)	12,000	15 – 25
Waste Grease or Vegetable Oil	4,800	80 – 110
Glycerol	400 - 800	135 - 145

Liquid unloading station

- 4,800 gpd = 1 tanker truck per day
- Transfer pump and quick disconnect station
- Truck piped directly to storage tank – no odor control needed
- Storage tank vent piping to facilities existing odor control
- Unloading control panel – view tank levels
- Construction costs = $150,000 to $200,000

Solids unloading

- 2,000 lb VS = 3 to 4 tons of food scraps per day
- Typically delivered in roll-off containers or dump trucks (1 to 2 trucks/day)
- Dump pit or Hopper
- Large screen
- Chopper/macerator
- Dilution system to add liquid and slurry to 5-7% solids
- Need odor control
- Construction costs
  - $400,000 to $500,000 if in existing building
  - $1.0 to $1.5 mil incl. new building

Substrate potential

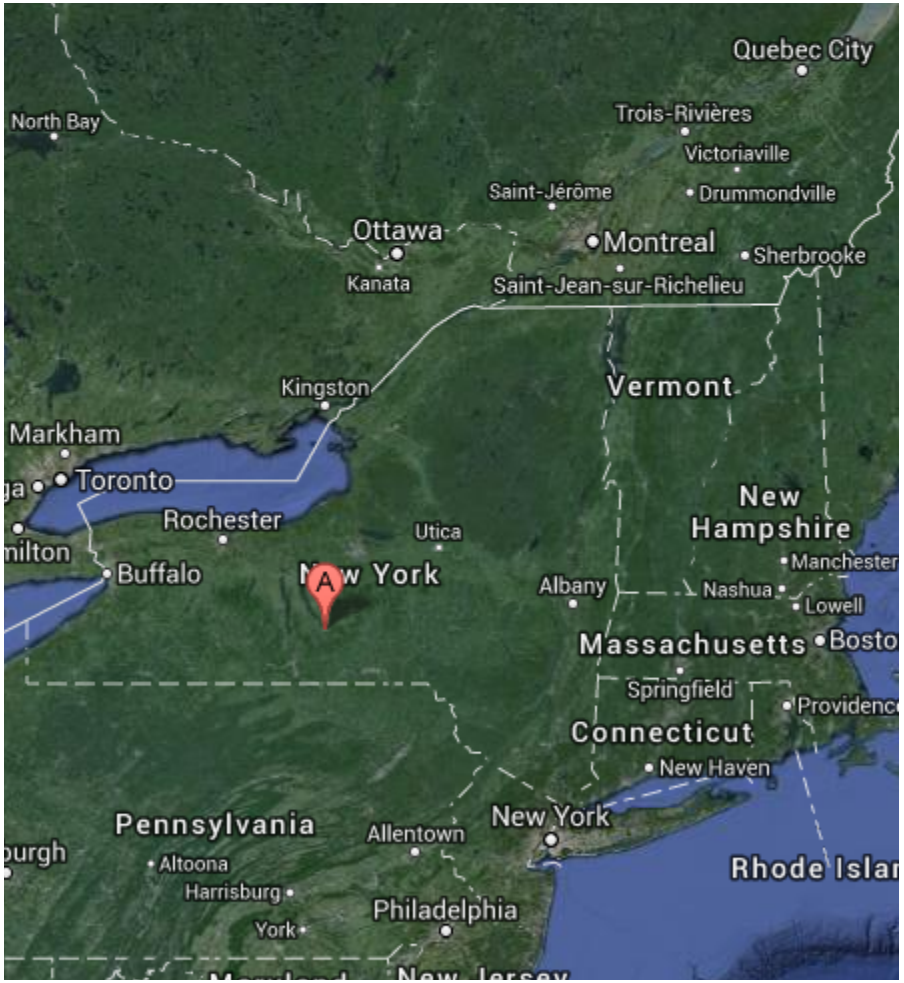
	Annual Tipping Fees Possible	Electrical Generation Potential (kW)	Annual Value of Electrical Generation	Annual Sludge Disposal Costs	Annual Net Benefit	Construction Costs	Simple Payback (years)
Yogurt waste	$87,600	41	$27,200	$35,900	$78,900	$175,000	2.2
Cheese waste	$87,600	41	$27,200	$35,900	$78,900	$175,000	2.2
Food processing byproducts	$87,600	64	$42,400	$35,900	$94,100	$450,000	4.8
Waste vegetable oil	$87,600	110	$72,600	$0	$160,200	$175,000	1.1
Source-separated organics (curbside pickup)	$0	69	$45,400	$35,900	$9,500	$450,000	47
Apple juice/vinegar waste	$87,600	14	$9,100	$35,900	$60,800	$175,000	2.9
Yellow grease	$0	110	$72,600	$0	$72,600	$175,000	2.4
Brown grease	$0	80	$53,000	$0	$53,000	$175,000	3.3
Glycerol	$0	138	$90,800	$0	$90,800	$175,000	1.9
Septage	$346,000	21	$13,600	$35,900	$323,700	$1,750,000	5.4

Notes:

1. Tipping fees based on $0.05 per gallon, which is typical of the New England market.
2. Tipping fees based on 4,800 gpd for 365 days per year.
3. Septage tipping fee based on $79 per 1,000 gallons
4. Value of electricity estimated at $0.11 per kWh, 6000 hours per year
5. Annual net benefit = Tipping Fee + Value of Electricy – Sludge Disposal Cost

Ithaca, NY

- Population – 30,000
- Several area universities
- Liberal community

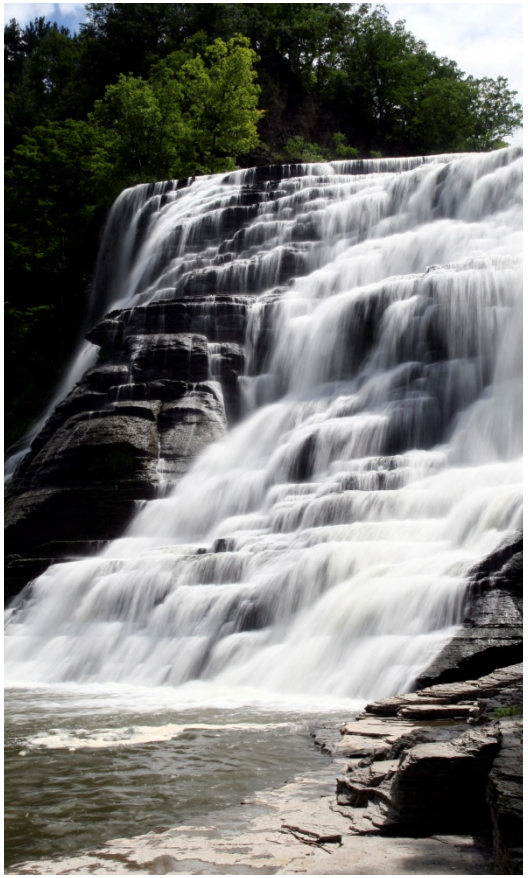


Ithaca Area Wastewater Treatment Facility (IAWWTF)

- 13.1 MGD facility
- Owned jointly by City of Ithaca, Town of Ithaca, Town of Dryden
- Primary and Secondary Anaerobic Digester
- Currently generates 25 – 30% of IAWWTF energy requirements

Ithaca community involvement

- Construction of new trucked waste receiving facility
- Constructed to accept food waste into anaerobic digester
- Facility coordinated delivery of food wastes from area universities and local grocery stores



Other Communities - Legislation

Toronto – Green Bin Program (2002)

- Mandatory for all City of Toronto residents receiving curbside collection.
- Sent to Dufferin Waste Management Facility

San Francisco Mandatory Recycling and Composting Ordinance (2009)

Massachusetts Commercial Organics Ban (2014)

Vermont Large Food Waste Generators (2014)

Factors to consider

- Existing infrastructure
- Excess capacity
- Siting potentially odorous process
- Tipping fee potential

Summary

- Several source separated waste streams economically viable to process at existing WWTP anaerobic digesters
- Mixed food waste streams require community involvement/legislation

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