The Benefits of Anaerobic Digestion of Food Waste At Wastewater Treatment Facilities

Why Anaerobic Digestion?

Anaerobic digestion occurs naturally, in the absence of oxygen, as bacteria break down organic materials and produce biogas. The process reduces the amount of material and produces biogas, which can be used as an energy source.

This technology is commonly used throughout the United States to break down sewage sludge at wastewater treatment facilities. In the past few years, there has been a movement to start adding food waste to anaerobic digesters already in place at wastewater treatment facilities.

The anaerobic digestion of food waste has many benefits, including:

- **Climate Change Mitigation** – Food waste in landfills generates methane, a potent greenhouse gas. Diverting food waste from landfills to wastewater treatment facilities allows for the capture of the methane, which can be used as an energy source. In addition to decreased methane emissions at landfills, there are greenhouse gas emissions reductions due to the energy offsets provided by using an on-site, renewable source of energy.
- **Economic Benefits** – Wastewater treatment facilities can expect to see cost savings from incorporating food waste into anaerobic digesters. These include reduced energy costs due to production of on-site power and tipping fee for accepting the food waste.
- **Diversion Opportunities** – Most municipalities are investing in ways to divert materials from landfills. This is usually due to reduced landfill space and/or recycling goals. Wastewater treatment facilities offer the opportunity to divert large amounts of food waste, one of the largest waste streams still going to landfills.

Why Food Waste?

Food waste is the second largest category of municipal solid waste (MSW) sent to landfills in the United States, accounting for approximately 18% of the waste stream. Over 30 million tons of food waste is sent to landfills each year. Of the less than 3% of food waste currently being diverted from landfills, most of it is being composted to produce a fertilizer.

There are many reasons to divert food waste from landfills, including:

- **Waste Diversion Goals** - Many states and local governments currently have mandated diversion goals. Aggressive recycling is one way that many communities are trying to meet diversion goals. However, organic waste- namely food scraps and yard waste- still makes up the

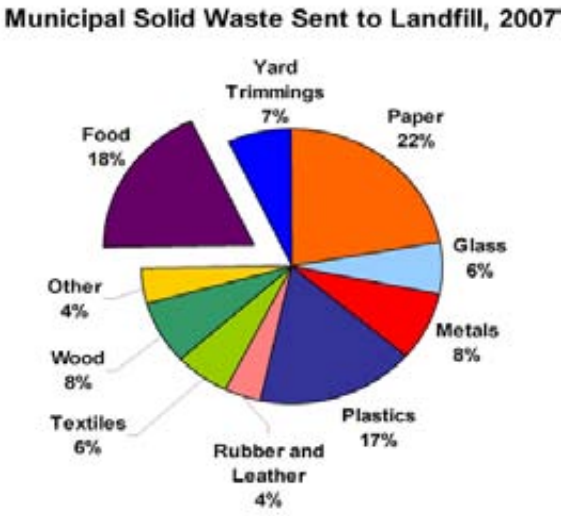

Figure 1. 2007 U.S. Waste Characterization showing materials disposed in landfills.

largest percentage of what is still being landfilled, and is often left out of recycling programs.

- **Easily Biodegradable –** Food waste is highly biodegradable and has a much higher volatile solids destruction rate (86-90%) than biosolids. This means that even though additional material is added to the digesters, the end residual will only increase by a small amount.
- **Renewable Energy Generation** – Arguably, the most important reason that food waste should be anaerobically digested is for capturing the energy content. Unlike biosolids and animal manures, post consumer food scraps have had no means of prior energy capture. In fact, in a study done by East Bay Municipal Utility District it was revealed that food waste has up to three times as much energy potential as biosolids.

Food waste has THREE TIMES the methane production potential as biosolids!

- Cattle manure= 25m³ gas/ton
- Biosolids= 120 m³ gas/ton
- **Food waste= 376 m³ gas/ton**

As energy prices continue to climb and our nation looks towards renewable energy generation and energy independence, capturing the energy from food waste becomes more important.

When facilities start digesting food waste, the increased energy production allows them to offset the amount of energy they are using and potentially sell excess energy back to the grid.

Why Wastewater Treatment Facilities?

Wastewater treatment facilities are an ideal place to increase the diversion of food waste.

- **Existing Infrastructure** – Many wastewater treatment facilities in Region 9 and across the country use anaerobic digesters to reduce the volume of the biosolids before they are taken off site. The anaerobic digesters produce biogas which is either flared or used on-site as an energy source. Therefore, the energy capturing infrastructure is already in place at many facilities.
- **Existing Expertise** – Wastewater treatment facilities already have the on-site expertise and years of experience dealing with anaerobic digesters; vessels that are difficult to operate without thorough knowledge.
- **Located in Urban Areas** – Wastewater treatment facilities are often located in dense, urban areas, where compost facilities are not. It makes logical sense for a highly populated area to ship organic waste to a nearby anaerobic digester where the energy content is recovered and the volume reduced. The residual can then be trucked to compost facilities, which are typically located farther from urban areas.

Parameter	Units	Food Waste Digestion				Municipal Wastewater Solids Digestion
		15-day MCRT		10-day MCRT		15-day MCRT
		Meso	Thermo	Meso	Thermo	Meso[1]
VS (as percent of TS), Feed	%	86.3	87	89.9	90.6	77
VS Loading, Feed	lb/ft^3-day	0.28	0.29	0.53	0.54	0.2[2]
COD Loading, Feed	lb/ft^3-day	0.55	0.57	1.09	1.11	0.06-0.3[3]
VSD	%	73.8	80.8	76.4	82.4	38-57%[4]
Methane (CH_4) Content	%	64	67	59	60	63
Methane Production Rate, Avg (Range)	ft^3/lb TS applied	13,300 (9,800–17,000)[5]		9,500 (6,600–14,400)[5]		10,000 (7,500–12,600)
	ft^3 per day/ 1,000 ft^3 digester volume	2,300 (1,100–3,200)		2,600 (1,800–3,800)		750 (550–930)
Residuals (Mass of Biosolids Produced) as a Percent of Feed Applied.	%	36	30	31	26	56-70

Notes:
1. Based on data from previous EBMUD bench-scale pilot study. Digesters were fed thickened waste activated sludge and screened primary sludge.
2. Maximum recommended loading rate, WEF MOP 8.
3. Maximum recommended loading rate, M&E, 4th Edition.
4. EPA 503 Regulations minimum is 38%. Typical average is 57% from EBMUD bench-scale pilot study.
5. Data combined for mesophilic and thermophilic digesters.

Figure 2. Summary of Parameters Comparing Anaerobic Food Waste Digestion to Anaerobic Municipal Wastewater Solids Digestion. (VS= Volatile Solids, TS = Total Solids, COD = Chemical Oxygen Demand, VSD= Volatile Solids Destruction)

How do I Make the Investment?

While many local governments and municipalities may be interested in processing food waste in anaerobic digesters at treatment facilities, they may feel that the cost is a limiting factor. However, there are many things to remember before immediately discounting this technology based on cost.

Payback period: Although the initial costs may be large, the digestion of food waste can be quite lucrative and the payback period can be less than three years depending on the existing infrastructure at the wastewater plant.

When a facility accepts food waste at a plant, they can charge the waste hauler a tipping fee for accepting the material. In addition, there is a significant amount of money that will be saved in energy avoidance due to methane production. The excess energy can be sold back to the grid for profit.

Funding Mechanisms:
While the short payback period may be an incentive for treatment facilities to invest in this technology, that doesn't necessarily mean that the up-front money is available.

For specific information on grants and funding opportunities, please see the Region 9 Water Sustainable Infrastructure funding page at http://www.epa.gov/region9/waterinfrastructure/

- **Federal and State Sources** can provide financial assistance. The federal government provides grants, loans, and rebates. California agencies also provide grants, loans, rebates, renewable credits, and stand-by rates for energy conservation practices. Local utility districts may provide private sources of funding.

Figure 3. This post-consumer food waste will produce energy and a soil amendment when anaerobically digested and then composted.

- **Performance contracting** is one way to pay for the infrastructure upgrades needed to implement anaerobic digestion at a wastewater treatment facility.

Performance contracting begins with a company hired to work with a locality or municipality. The company studies the potential energy savings of a particular investment, in this case the excess methane that will be produced during the anaerobic digestion of food waste. The performance contractor then provides the upfront capital needed to invest in the new infrastructure and installation costs. They are paid back with the energy savings of the municipality. The locality will start to gain the energy income after the contractor has been paid back.

- **Grants** are another option to secure funding for implementing new infrastructure. Many state and local organizations are looking for new ways to promote renewable energy sources. Although applying for and receiving grants can be a long and arduous process, grants are the ultimate source of funding as they do not have to be paid back. However, some grants do require the awarded organization to provide a match in funding.

- **Other Funding Sources:** If your situation does not allow for performance contracting and seeking grants has been an unsuccessful venture, there are still ways to secure funding. Consider options such as; loans, venture capitalist money, research and development budgets, and state funds promoting renewable energy sources. In addition, consider conducting an economic analysis that would compute the payback period and cost savings for your specific situation. When presented to local officials, a private board, etc. they may be more willing to invest in the technology when they see the financial potential.

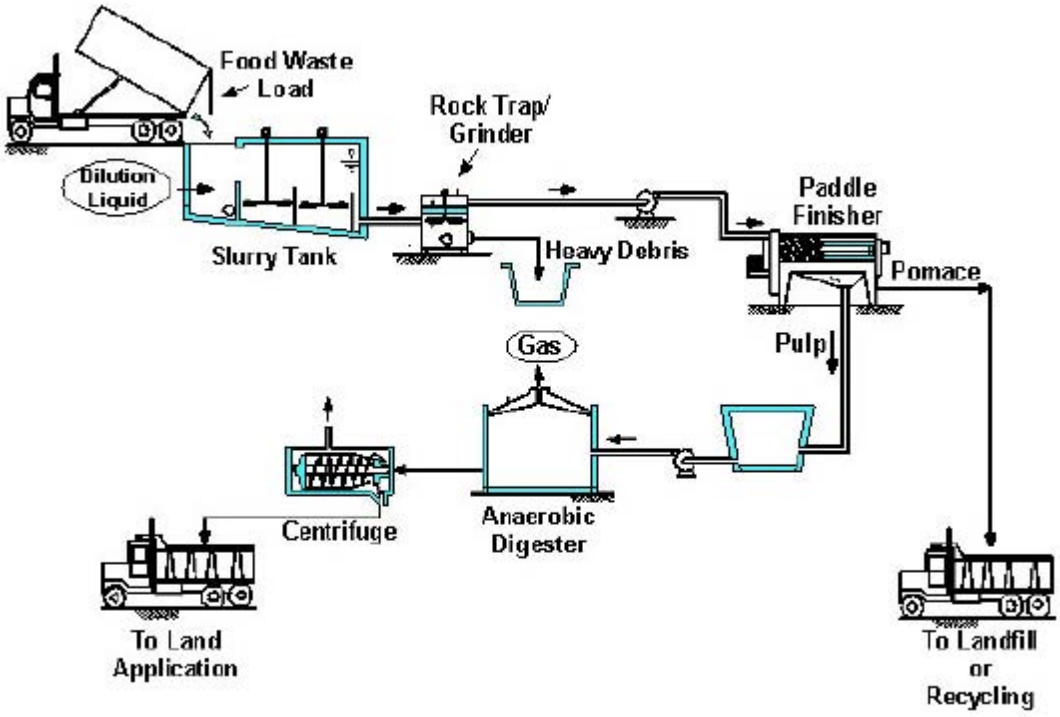

Figure 4: The East Bay Municipal Utility District Food Waste Treatment Process. The process accepts ground food waste, removes contaminants through a series of steps and ultimately anaerobically digests a clean, homogenous, and rich in energy food waste mixture.