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Promoting World Peace through Economic Prosperity

SuperAnaerobicDigestion™ of Municipal Solid Wastes for Renewable Energy and Potable Water Production

Over the last 80 years, anaerobic digestion treatment throughout the world has been consistently viewed by researchers, practitioners, and end users alike, as a rather simple phenomenon of nature rather than a biochemical engineering process.

The Institute of Gas Technology is a trade association of the natural gas industries. To its credit, it was the first marketplace entity to manage mesophilic anaerobic reactions as a biological process by successfully establishing the economic viability of two-phase anaerobic treatment.

WaterSmart Environmental, Inc. improved this step by adding:

- ♦ Fixed or attached growth media = captive bacteria population
- ♦ Thermophilic bacteria = 4 times the mesophilic metabolic rate
- ♦ Staged treatment in each phase = greater efficiency
- ♦ Nutrient addition in both phases = greater efficiency
- ♦ Flow recirculation in all phases and stages = greater efficiency
- ♦ pH and temperature control in all stages = greater efficiency

As a result, two-phase, two-stage, thermophilic, fixed growth, anaerobic digestion process:

- ♦ Accomplishes extremely high levels of treatment
- ♦ Is only half the cost of existing anaerobic treatment technologies
- ♦ Generates methane gas and carbon dioxide gas as co-products
- ♦ Generates twice the methane gas as existing anaerobic digestion technologies
- ♦ Is only 10% the physical size of existing anaerobic treatment technologies
- ♦ Makes all aerobic and other anaerobic technologies obsolete
- ♦ Is the dominant technology in municipal privatization
- ♦ Is the dominant biowastes to energy process
- ♦ Can be used to produce hydrogen gas, vinegar, and additional first-phase commodities
- ♦ Produces a positive return on investment

Anaerobic Digestion Process Benefits:

- ♦ Sludge qualifies as Class A Biosolids
- ♦ Reduced landfill disposal costs
- ♦ Reduced sludge hauling costs
- ♦ Reduced chemical conditioning costs
- ♦ No energy required for routine plant operation
- ♦ Excess energy generated for profit
- ♦ Greatly reduced (about 90%) land area required
- ♦ Elimination of effluent disinfection
- ♦ Greatly reduced (about 30%) plant acquisition costs

- 💧 Elimination of greenhouse gasses
- 💧 High quality carbon dioxide generated for beneficial use
- 💧 High quality methane gas generated for beneficial use
- 💧 No detectable odors
- 💧 Removal of Heavy Metals
- 💧 Removal of environmentally dangerous hydrogen sulfides by conversion to innocuous sulfates

Incineration of municipal solid wastes to produce steam which, in turn, drives a steam turbine generator to produce electricity is already preferred by the Government of Germany, the Government of Hong Kong, the Government of United Kingdom of Great Britain and Northern Ireland, and the Government of the State of Hawaii. See <http://www.covanta.com/en/sustainable-solutions/energy-from-waste.aspx>

Incineration of municipal solid wastes represents extremely outdated technology. Modern technology consists of the anaerobic digestion of municipal solid wastes that produces over 1,000 times more electricity than **incineration** on a per pound of MSW managed basis!

WaterSmart Environmental, Inc. has been able to slowly develop the modern management of MSW over the last 20 years that yields over 1,000 times the marketplace benefits than those produced by **incineration**. The referenced modern management of Municipal Solid Wastes may be referred to as the *SuperAnaerobicDigestion™* technology.

The *directly* produced marketplace co-products include:

1. Carbon Dioxide Gas
2. Methane Gas

The *indirectly* produced co-products include:

1. Renewable electricity power
2. Biodiesel B100 (a direct replacement for petroleum diesel)
3. Bio-Methanol (a direct replacement for gasoline)
4. Liquefied Methane Gas (LMG)
5. Liquefied Nitrogen Gas (LIN)
6. Liquefied Oxygen Gas (LOX)
7. And free potable water (H₂O).

The *WaterSmart Environmental, Inc. SuperAnaerobicDigestion™* technology management of MSW yields many economic benefits. These benefits include:

1. The production and marketing of inexpensive electricity,
2. The production and marketing of inexpensive biofuels,
3. The production and marketing of inexpensive organic foods,
4. The production and marketing of inexpensive methane gas,
5. The production and marketing of inexpensive carbon dioxide gas,
6. The production and distribution of free potable water,
7. The manufacturing and marketing of very large 4-story, 5-bedroom homes that use inexpensive methane gas (a far more economical cooking and heating gas than natural gas) and inexpensive electricity. The homes include solar panels that directly enable the greenhouse production of fresh live shrimp, live tilapia, organic fruits, and organic vegetables,
8. The production and marketing of organic fertilizer,
9. The production and marketing of liquid fertilizer concentrate,
10. The production and marketing of ferrous metals, and
11. The production and marketing of non-ferrous metals.

The **SuperAnaerobicDigestion™** treatment of 1,000 tons of MSW/day produces a 60 MW combined cycle green electricity power generation facility, referred to as a **renewable energy**, that will be sold to the marketplace at US\$0.02/kWh plus government taxes.

SuperAnaerobicDigestion™ treatment of 1,000 tons of MSW/day can produce 3,000,000 gallons of biodiesel biofuel/day, referred to as **B100** (see <http://www.biodiesel.org/what-is-biodiesel/biodiesel-fact-sheets>). The biodiesel will be produced within a photobioreactor that uses *Chlorella vulgaris* microalgae. The *Chlorella vulgaris* microalgae will consume the carbon dioxide as a feed source from the adjacent anaerobic digester. The produced **B100 Biodiesel** will be sold to the marketplace at a price of US\$1.00/gallon plus government taxes.

Anaerobic digestion treatment of 1,000 tons of MSW/day will also produce more than 3,000,000 gallons of bio-methanol/day, referred to as **Bio-Methanol** (see <http://www.biomcn.eu/our-product/bio-methanol.html>). **Bio-Methanol** is a perfect substitute for gasoline with the understanding that the motor vehicle's fuel pump Viton seal must be replaced with an economical Buna-N seal. The **Bio-Methanol** will be sold to the marketplace at a price of US\$1.00/gallon plus government taxes.

Anaerobic digestion treatment of 1,000 tons of MSW/day will also produce 100 tons of carbon dioxide CO₂/day that will be used internally to produce **biodiesel** and **biomethanol** that will be sold to the marketplace at US\$0.10/pound plus government taxes.

Anaerobic digestion treatment of 1,000 tons of MSW/day will also produce 200 tons of liquid fertilizer concentrate/day that will be used internally within the greenhouse and/or sold to the marketplace at US\$0.25/fluid ounce plus government taxes.

The nearby Johnson County Landfill receives more than 1 million tons of MSW/year which equates to more than 2,700 tons of MSW/day. Each ton of MSW produces 0.24 tons of methane gas (CH₄)/day through anaerobic digestion. 2,700 tons of MSW therefore produces 0.24 x 2,700 = 648 tons of methane gas (CH₄)/day. 648 tons of (CH₄/day) x 2,000 lbs/ton = 1,296,000 lbs CH₄/day. Since the weight of methane gas = 0.0422 lbs/cubic foot, 1,296,000 lbs/cubic foot ÷ 0.0422 = 30,710,900 cubic feet of methane gas will be produced/day.

Since 7,000 cubic feet of methane gas produce 1 MWh of electricity, 30,710,900 cubic feet of methane gas ÷ 7,000 cubic feet of methane gas/MWh = **4,387 MWh of combined cycle renewable energy/day** can be produced from each ton of MSW. When converted into an annual power generation figure, it is 2.6 times the total electricity necessary to power the entire States of Iowa, Kansas, Nebraska, and Missouri! The **renewable energy from the nearby Johnson County Landfill** will be sold directly to the States of Iowa, Kansas, Nebraska, and Missouri at **US\$0.02/kWh** plus government taxes. The States of Iowa, Kansas, Nebraska, and Missouri also comprise Region 7 of the United States Environmental Protection Agency.

Each ton of methane gas also produces 2.75 tons of water from the generation of electricity. 648 tons of methane gas/day x 365 days/year x 2.75 tons of water = 650,430 tons or x 2,000 lbs/ton = 1,300,860,000 billion gallons of water produced/year when converted into annual figure. With a daily requirement of 100 gallons/day/adult the supply of potable water equates to 1,300,860,000 ÷ 100 = 13,008,600 gallons/year or when divided by 365 days/year = 35,640 gallons/day. With a combined population of Iowa, Kansas, Nebraska, and Missouri = 15,000,000, the potable water available/person/day = 15,000,000 ÷ 35,640 = 420 gallons/day/person or 4.2 times the 100 GPD gallons/day/person potable water requirement. **The excess (420 GPD/person – 100 GPD/person) water = 320 Gallons/Day/person x 15,000,000 combined population of Iowa, Kansas, Nebraska, and Missouri = 4,800,000,000 Gallons/Day will be pumped to the thirsty Ogallala Aquifer in response to Governor Brownback's call to action for a 50 Year Vision to ensure the state's current and future supply needs are addressed and permanently solved.**

Since 9% of MSW constitutes scrap metals (aluminum, arsenic, cadmium, chromium, cobalt, copper, gold, iron, lead, manganese, mercury, nickel, silver, steel, tin, and zinc), 2,700 tons MSW produce $0.09 \times 2,700 = 243$ tons of scrap metals/day. At an estimated minimum value of US\$1.00/lb., 243 tons $\times 2000$ lbs/ton = 486,000 lbs of scrap metals that are worth US\$486,000.00/day or $\times 365 =$ US\$177,390,000.00/year. See <http://www.scrapregister.com/scrap-prices/united-states/260>

Since 26% of MSW constitutes non-biodegradables/day, 2,700 tons MSW produce $0.26 \times 2,700 = 702$ tons of non-biodegradables/day. After mechanical crushing and grinding, this material will be used to produce the concrete that will be used to construct the project building itself, a multistory greenhouse power generation facility. The greenhouse will produce **renewable energy electricity, biofuels, carbon dioxide gas, methane gas, and organic foods.**

Marketplace inquiries may be mailed to: Technical Director, *WaterSmart Environmental, Inc.*, PO Box 26346, Shawnee Mission, KS 66225-6346

email inquiries may be sent to wefindsolutions@watersmart.com

PROPRIETARY

*Specialists In Potable Water, Waste Water, and Storm Water Treatment
Featuring BioWastes to Renewable Energy, Biofuels, Organic Foods, and
Potable Water Independence Technologies by and for the Common Man*

