

MSW-To-Energy.

...includes food and green wastes

...with aquifer recharge!

Made possible by the

OATTM

**Optimized Anaerobic
Treatment Process**

Zero Wastes to Landfill.

- 🔹 All ferrous and non-ferrous metals sorted out and recycled.
- 🔹 Glass, rubber, leather, plastics, and other residuals are ground and digested.
- 🔹 All remaining organics are also anaerobically digested.

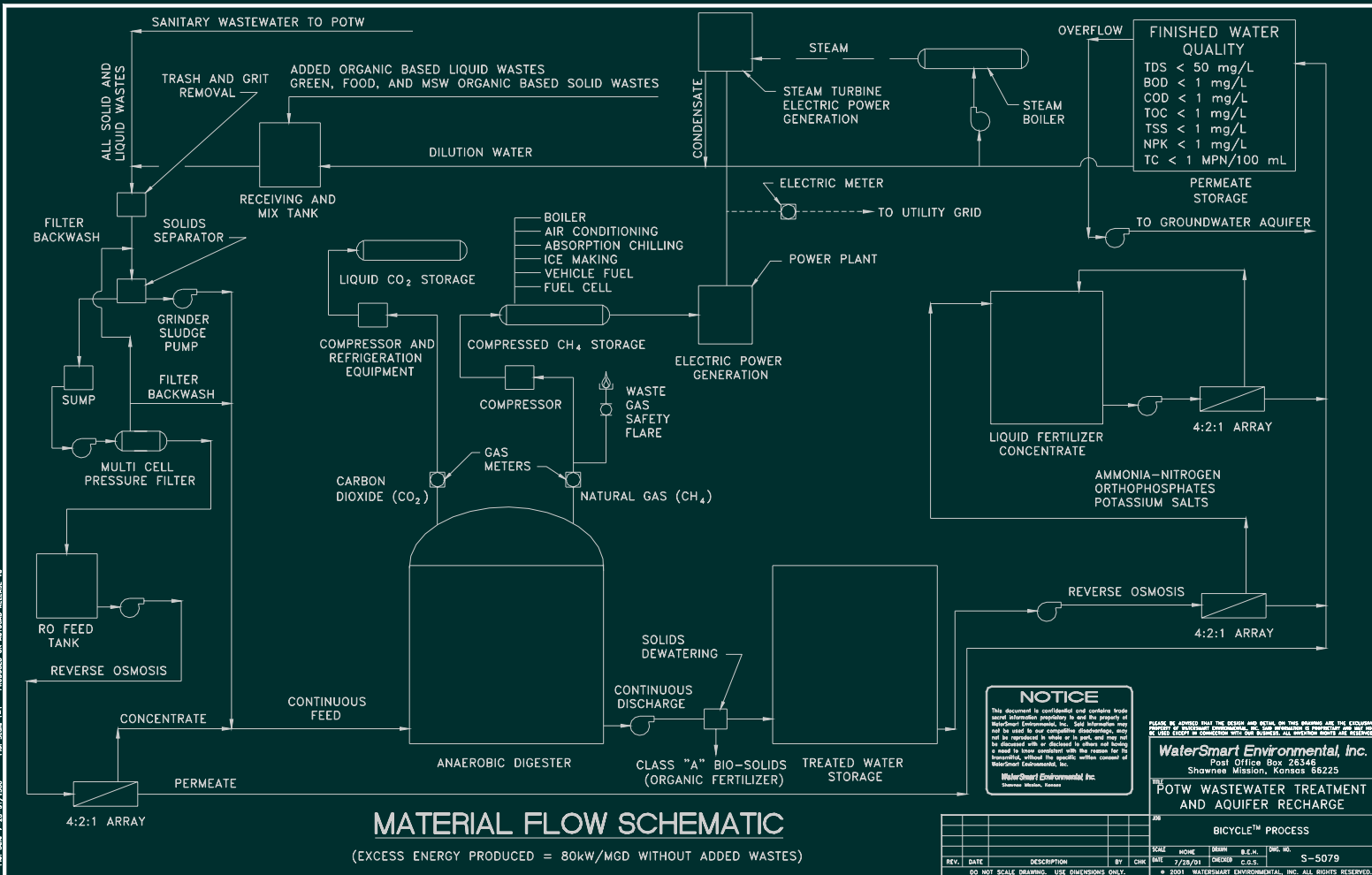
Digester Co-Products.

- 💧 Methane gas
- 💧 Carbon dioxide gas
- 💧 Organic fertilizer – 30% moisture
- 💧 Liquid fertilizer concentrate
- 💧 Reverse osmosis permeate water

Combined Cycle Electricity Generation.

- 💧 Methane gas is used to generate electricity with reciprocating engines or gas turbines.
 - 💧 Waste heat from methane gas electric power generation is used to make steam.
 - 💧 Steam is then used in a steam turbine generator to make additional electricity.
- ... Very efficient cogeneration of electricity.

Total Treatment Design.



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 Prof. Scale: 1:1
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Solids (Digestate) Composition.

- 💧 Grit and sand.
- 💧 Insoluble Sulfides of Cadmium, Calcium, Copper, Iron, Lead, Manganese, Trivalent Chromium, and Zinc.
- 💧 Approximately 1-1-1 NPK (Nitrogen, Phosphorus, and Potassium)
- 💧 Qualifies as Class “A” Biosolids in compliance with 40 CFR Part 503
- 💧 Also Qualifies as Organic Fertilizer

Solids Management.

- 💧 May be sold to the marketplace as an organic fertilizer commodity.
- 💧 May be sold to the marketplace as a soil amendment.

Liquid Streams.

- 💧 Liquid fertilizer concentrate.
- 💧 Reverse osmosis permeate.

Liquid Fertilizer Concentrate.

- 💧 Contains about 20-10-10 NPK in a 70% water solution.
- 💧 Contains trace amounts of aluminum, magnesium, and sodium salts

Reverse Osmosis Permeate Water.

- 💧 Total dissolved solids < 50 mg/L
- 💧 Total coliform count < 1MPN/100 mL
- 💧 BOD < 1 mg/L
- 💧 COD < 1 mg/L
- 💧 TOC < 1 mg/L
- 💧 TSS < 1 mg/L
- 💧 NPK < 1 mg/L

Liquids Management.

- 💧 Liquid fertilizer concentrate may be sold to the marketplace as a commodity.
- 💧 Reverse osmosis permeate water may be used for aquifer recharge or irrigation.

Other Co-Products.

- 💧 Methane gas.
- 💧 Carbon dioxide gas.

Co-Product Methane.

- 💧 Is compressed, dried, and stored at 300 psig for possible site use and for the generation of electricity.
- 💧 Compressed methane may also be sold as CNG (compressed natural gas).
- 💧 Generated electricity may be used at site as well as sold to utility grid.

Co-Product Carbon Dioxide.

- 💧 Is compressed, dried, purified, liquefied, and stored at 300 psig for sale to the marketplace as a commodity.
- 💧 Meets food and medical grade quality.

Co-Product Management.

- 💧 No release of methane gas to the environment.
- 💧 No release of carbon dioxide gas to the environment.
- 💧 No gas releases accomplish a 500%+ reduction in greenhouse gas effect.

Odor Control.

- 💧 MSW receiving and sorting building is kept under negative pressure thereby preventing odor escape to the environment.
- 💧 Air quality within receiving and sorting building is continuously purified by vapor phase activated carbon.

The OAT™ Process.

Is the *only* process that combines:

- 💧 Two-phase Anaerobic Digestion
- 💧 Thermophilic Bacteria
- 💧 Staged Phase Treatment
- 💧 Fixed Growth Media
- 💧 Flow Recirculation
- 💧 pH and Temperature Control
- 💧 Essential Nutrient Addition

Bacteria Can Produce Fuel From Liquid & Solid Wastes.

- 💧 Solid waste landfills biologically generate methane gas (called *biogas*) as clear evidence of the ability of bacteria to produce fuel.
- 💧 Biogas is a mixture of carbon dioxide and methane gas. It has a heating value of about 25,000 kJ per cubic meter.
- 💧 Biogas may be used as a primary fuel or to generate electricity.

Wastewater Treatment Plants Use Bacteria.

- 💧 Almost all wastewater treatment plants use bacteria to treat the water.
- 💧 Aerobic plants use aeration. They *consume* about 8,000 kJ per kg COD (Chemical Oxygen Demand) removed.
- 💧 WaterSmart's OAT™ anaerobic plant *generates* about 22,000 kJ/kg COD for an energy improvement of about 30,000 kJ/kg COD.

Wastes That Can Be Converted Into Methane.

- 💧 Municipal Wastewater
- 💧 Landfill Leachate
- 💧 Chemical Manufacturing
- 💧 Pulp & Paper Mills
- 💧 Sugar Mills
- 💧 Palm Oil Mills
- 💧 Breweries & Distilleries
- 💧 Fish & Food Processing
- 💧 Agricultural Solid Wastes
- 💧 Cardboard & Sawdust
- 💧 Ethanol Plants
- 💧 Rubber Plantations

...More Eligible Wastes.

- 💧 Animal Feed Lot Wastes
- 💧 Dairy & Cheese Production
- 💧 Fruit & Vegetable Canning
- 💧 Pharmaceutical Wastes
- 💧 Rendering Plants
- 💧 Textile Manufacturing
- 💧 Municipal & Industrial Digester Sludge
- 💧 Municipal Solid Wastes

A Renewable And Alternative Energy Source.

- 💧 These many wastes are generated each and every day in the normal course of living.
- 💧 The routine treatment or disposal of wastes is tremendously *expensive*.
- 💧 The OAT™ process, however, makes their conversion into methane gas and other co-products *profitable*, an extremely pleasant surprise.
- 💧 This was made possible by viewing wastes as a resource rather than a burden on society.

Excess Energy Produced.

- 💧 The OAT process uses some of the methane it generates to heat the wastewater being treated.
- 💧 The excess methane can be sold, used to operate equipment, or generate electricity.
- 💧 The excess green power electricity can be used by the treatment plant, sold to the local electric utility, or even to a distant business or city through the Internet.

Positive Return On Investment.

- 💧 When one generates a profit from the treatment of wastes, a *positive return on investment* (ROI) always results.
- 💧 Rather than a burden on society, wastes may now be viewed as an **asset**--an incredible reversal of common perception.
- 💧 Wastewater treatment plants of the patented OAT™ design pay for themselves!

Energy Costs.

- 💧 Wastewater treatment is very expensive, particularly because of energy costs which increase at 3-5% every year.
- 💧 A typical biological wastewater treatment plant uses about 8,000 kJ per kg COD (Chemical Oxygen Demand) removed.
- 💧 WaterSmart's OAT process can produce up to 22,000 kJ/kg COD removed, for an *energy improvement* of about 30,000 kJ per kg COD.

Capital Equipment Costs.

- 💧 Are also very expensive, on the order of US\$2K+ for every kg of COD treatment capacity.
- 💧 If ammonia, nitrate, phosphorus, or heavy metal removals are required, the associated costs are much higher.
- 💧 WaterSmart's OAT™ Anaerobic Treatment Plant costs about half as much as other anaerobic systems treating the same amount of COD or Volatile Solids.

Environmentally Friendly And Sensible.

- 💧 Korea's Sudokwon Landfill, the world's largest, has the motto: *"Don't Waste Wastes."*
- 💧 We share that view and believe wastes should be converted into something useful, like fuel or electricity, if it can be done so safely and economically.
- 💧 In so doing, waste volumes are greatly reduced to better manage the environment for ourselves and the next generation.

Odors?

Absolutely None!

- 💧 All treatment is carried out in closed vessels
- 💧 Hydrogen Sulfide is removed from produced biogas.
- 💧 All gasses are captured and used or recycled. None escape.

Environmental Damage? Absolutely None!

- 💧 No emissions to atmosphere
- 💧 Heavy metals removed as insoluble sulfides
- 💧 Organic constituents are converted into methane gas.
- 💧 All nutrients are captured and recycled.

Beneficial Co-Products

In addition to **methane gas**, the OAT™ process generates other useful and profitable co-products.

- 💧 Carbon Dioxide
- 💧 Organic Fertilizer
- 💧 Liquid Fertilizer Concentrate
- 💧 Reverse Osmosis Permeate Water

Greenhouse Gasses

- 💧 A methane powered generator or gas turbine will discharge EPA permissible amounts of carbon dioxide when producing electricity.
- 💧 If a fuel cell is used to make electricity, no carbon dioxide is discharged.
- 💧 No methane is ever discharged to the environment.

Noise...

Practically none!

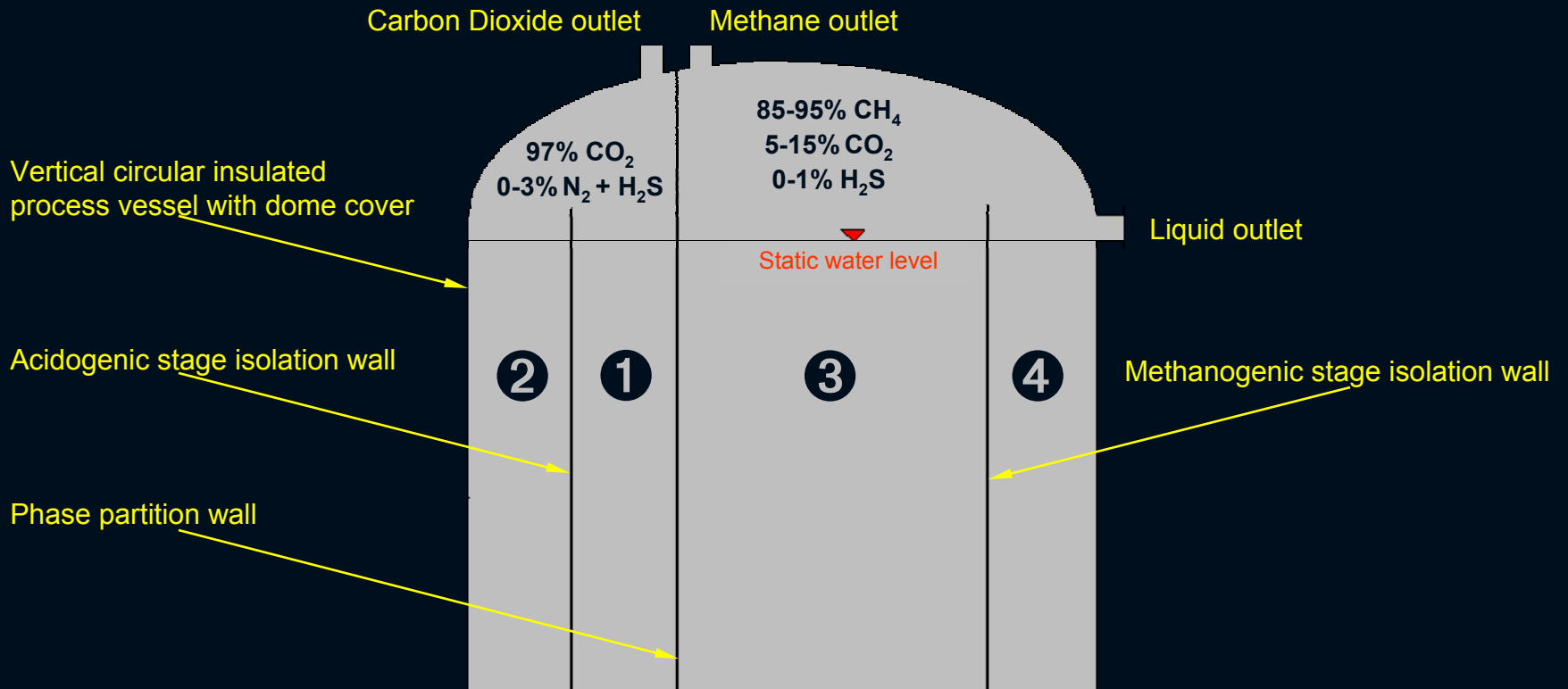
The loudest component is a biogas powered generator or turbine -- similar to a truck engine.

Noise producing equipment can easily be enclosed for noise attenuation

Sludge

- 💧 0.01 pounds of solids produced for every pound of BOD removed—about 25% that of competitive anaerobic treatment plants!
- 💧 OAT™ process sludge qualifies as **Class “A” Biosolids** that can be sold as fully certified organic fertilizer.

Single Vessel Design.



① 1st stage acidogenic digester

② 2nd stage acidogenic digester

③ 1st stage methanogenic digester

④ 2nd stage methanogenic digester

Headworks.

- 💧 Trash and grit removal.
- 💧 Grind or comminute the raw wastewater.
- 💧 No primary treatment required.
- 💧 Biosolids may be ground and added.
- 💧 Organic solid wastes may also be added.
- 💧 Liquid organic wastes may also be added.
- 💧 Green wastes may also be added.
- 💧 Food wastes may also be added.

Sophisticated Design But Easy To Operate.

- 💧 Automatic controls simplify routine plant operations.
- 💧 Close process control translates into a high degree of treatment efficiency.
- 💧 Minimal plant operator skill required.

OAT Upgrades Available.

- Existing anaerobic digesters may usually be upgraded to the OAT process thus saving project site construction and piping costs.
- A complete upgrade to the OAT process can increase the digester organic loading capacity 10 times.
- Beneficial use or sale of the produced methane gas, generated electricity, Class A biosolids, reverse osmosis permeate water, and carbon dioxide gas makes the upgrade a positive ROI.

Summary.

- 💧 Wastes can be beneficially converted into fuel or electricity.
- 💧 An efficient anaerobic treatment process results in a positive return on investment.
- 💧 The OAT™ process is the **most efficient** anaerobic treatment available worldwide.
- 💧 OAT™ plants are smaller, less expensive, do not smell, and generate a profit.
- 💧 Reverse Osmosis permeate water can be used for aquifer recharge.

For Project Feasibility Studies and Proposals

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