RENEWABLE ENERGY

Producing renewable energy from food-processing waste

BEST PRACTICE

BIOMASS

SOLAR

WIND

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The food-processing industry is in a unique position to use its own waste products to generate renewable energy, thereby reducing processing costs, achieving environmental benefits, and creating a hedge against rising energy costs. As local energy security becomes imperative, companies are finding increased access to capital and grants for renewable energy projects. Many firms are also considering additional financial returns in the future for renewable tax credits or carbon trading options. Utilizing renewable energy also allows processors to take advantage of environmental attributes for market positioning or "green" promotion opportunities.

Biogas digesters (also called anaerobic digestion systems) are powerful tools for managing high-strength, organic wastes from farms, food-processing facilities, and waste-water treatment plants. In most cases it makes sense to conduct an in-depth analysis prior to installing a biogas digester in order to better understand costs and benefits, best technologies, and designs, as well as technical, economic, and regulatory issues. There are many factors that are of foremost importance when determining performance and design for renewable energy production from food-processing waste.

The following are key best practices to consider when conducting an in-depth feasibility study prior to installing a biogas digester system:

BIOGAS DIGESTER SYSTEM WASTEWATER CHARACTERIZATION

Feedstock quality, pH levels, presence of bio-inhibitors

The quality of the feedstock in terms of its gas yield will partly depend on its freshness: The fresher it is the higher the gas yield will be and the less danger there is of it becoming acidic. An acidic feedstock may inhibit or even kill the bacteria in the digester. Ideally, the pH range in the digester should be 6.8–8. Inhibitors include bio-agents (aflatoxins, antibiotics), toxic materials (pesticide residues, high ammonia levels, oils, heavy metals), and disinfectants (phenol, arsenic, bleach).

Parasites and pathogens in feedstock

Mesophilic or thermophilic digestion systems will greatly reduce pathogenic organisms and bacteria, but

are not likely to totally eliminate pathogens in the feedstock. Additional heat treatment may be necessary to ensure the complete elimination of pathogens. It should be noted that heat treatment will affect the energy balance by increasing energy consumption.

Clean Water Act Part 503 regulations define Processes to Further Reduce Pathogens (PFRPs). Based on feedstock and class of biosolids required, further reduction of pathogens may need to take place after the digestion process.

WASTEWATER FLOW AND LOADINGS

- Data for historic or current flow
- Chemical oxygen demand (COD) value(s)
- Total suspended solids (TSS)
- Processing waste temperature
- Trace metal deficiency assay
- Anaerobic toxicity assay (ATA)
- Biochemical methane potential assay (BMP)

BASIS OF DESIGN

- Regulatory requirements
- Space available
- Storage of material
- Material handling system(s)
- Retention time, digester sizing
- Safety of digestate
- Ease of operation considerations
- Start-up and shut-down processes
- Transportation to treatment facility or off-site after treatment

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The power is within you.

- Plans for future expansion
- Pre-treatment and design accommodations
  - ☐ Screening for foreign matter
  - ☐ Adding or removing water
  - ☐ Conditioning waste (grinding, shredding)
  - ☐ Stirring feedstocks (equalizing batches)
  - ☐ Waste stream from cleaning and clean-in-place operations
  - ☐ Continuous feedstock or batch-process waste
  - ☐ Effects due to low loading rates, chemical precipitation, struvite formation, foaming
- Biogas clean up or post-treatment
- Drying gas
- Removal of siloxanes, sulfur, magnesium, or other contaminants
- CO_2 removal
- Gas compression
- Mass/flow balance and process flow diagram

EVALUATION OF ANAEROBIC SYSTEM PERFORMANCE

- Biogas analysis, possible bench-top testing
- Predicted biogas production
- Any benefits of bio-additives (enzymes or microbial mixtures) or micronutrients
- Batch or continuous-process analysis
- Biogas storage analysis
- Thermal performance and predicted heat generation, adequacy of heat to run process
- Alkalinity requirements
- Startup time factor

EVALUATION OF ELECTRICAL SYSTEM

- Usable biogas production
- Predicted electrical power generation
- Parasitic loads (from equipment and instruments required to operate any cogeneration system)
- System backup requirements
- Utility interface requirements

COST ANALYSIS FOR RECOMMENDED ALTERNATIVES

- Capital cost
- Operation and maintenance costs
- Training costs
- Payback

CHECKLIST OF QUESTIONS

Focus on Energy recommends you consider the questions below prior to installing a biogas digester system:

- Will the system meet regulatory requirements?
- Is the system flexible enough to meet changes in process waste and different levels of plant operation?
- Will any toxic materials be able to be biodegraded in the process? Is it difficult or costly to remove or accommodate bio-inhibitors in the waste?
- Will the base process biomass be retained in the system?
- How will the reactor vessel be maintained? Can material be removed without shutting down the whole system?
- How long is start-up and what is required for shut-down?
- What are possible process upsets or shocks? Can they be avoided or mitigated?
- How resistant will the system be to upsets or shocking?
- Does the engine generator match the average gas output of the system? Is a back-up generator required?
- Is on-site testing available for periodic process evaluation and monitoring?
- Will the system accommodate new products and waste streams?
- Does the system seem reasonable and workable in construction, operation, ongoing monitoring, and future maintenance?
- Due to the complexity of the feedstock or processing, is there a need for bench-scale testing?

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Focus on Energy works with eligible Wisconsin residents and businesses to install cost-effective energy efficiency and renewable energy projects. Focus information, resources, and financial incentives help to implement projects that otherwise would not be completed, or to complete projects sooner than scheduled. Its efforts help Wisconsin residents and businesses manage rising energy costs, promote in-state economic development, protect our environment, and control the state's growing demand for electricity and natural gas. For more information, call **800.762.7077** or visit **focusonenergy.com**.

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