High-Rate Anaerobic Digester Systems for Industrial Wastewater Treatment and Renewable Energy Generation

THE POWER OF WASTE: RNG FOR COLORADO
Energy Vision & Denver Metro Clean Cities

Presented by:
Manaf H. Farhan, Ph.D., P.E.
EMG International, LLC
Media, PA 19063

May 19, 2016
Presentation Outline

- Anaerobic Digestion Process Fundamental
- Common Anaerobic Reactor Configurations
- Industrial WW Treatment Project Overview
- Wastewater Characterization/Sampling
- Case Study #1—Brewery Digester System
- Case Study #2—Cheese Plant Digester System
Global Prospective on Biological Treatment

- Gradual awareness of Aerobic process disadvantages
- Advantages of Anaerobic Biotechnology
- Disadvantages of Anaerobic Biotechnology
- Innovative reactor configurations & PLC/SCADA technology
- Strategic shift towards Anaerobic processes
- Reliable resource for RNG generation
Anaerobic Digestion Process Steps

- Hydrolysis and liquefaction
- Fermentation (complex waste breakdown)
- Shorter-chain organic acids formation
- Hydrogen and Acetic Acid formation
- Methane and Carbon Dioxide formation
Available Anaerobic Digestion Systems for Wastewater Treatment

**Low-Rate**
- Completely-mixed
- Plug Flow

**High-Rate**
- Fixed–Bed
- Sludge Blanket
- Anaerobic Fluidized Bed Digester
Industrial Wastewater Treatment Project Overview

- System treatment goals (compliance, financial, environmental, growth projections)
- System permitting requirements
- Wastewater characterization/sampling
- Developing engineering design basis
- Project schedule/accessibility
- Project team/execution
- Long-term operation/deliverables
WW Characterization/Sampling

- Understanding WW generation process
- Process-related WW flow rate determination (Ave/Max/Variability)
- Sample locations and collection
- Analysis parameters
- Effect of cleaning chemicals/biocides
- Expected plant production growth
Case Study #1:

Anaerobic Fluidized Bed Digester (AFBD) System for Brewery WW Pre-Treatment and Renewable Energy Generation
Relevant Factors for Brewery WW Pre-Treatment Applications

- Brewery WW pre-treatment goals
- Locating and recovering brewery WW
- Targeting high organic loading sources
- Brewery cleaning and sanitizing activities
Typical Brewery Chemicals Affecting The Anaerobic Digestion Process

- Cleaning Chemicals/CIP
- Sanitizers/Biocides
- Lubricants
- Other Chemicals/Chelating agents
Relevant Factors for Brewery WW Pre-Treatment Applications

- Required wastewater screening
- Required wastewater equalization
- Available space and accessibility
- Optimal system layout
- Operational requirements for brewery AD system
- Maintaining required environmental conditions in Digester system
- Optimizing heat exchange & waste heat recovery
Project Work Completed

- Brewery WW sampling/characterization
- System sizing and design
- Digester system component fabrication
- System layout and required footprint
- System controls and on-line monitoring
- Project construction
- Digester system start-up/Long-term operation
AFBD System Components for Brewery WW Treatment

- Anaerobic Fluidized Bed Digester units
- Nutrient feed system
- Biogas collection/conditioning system
- Biogas utilization unit (Genset, boiler, etc.)
- Emergency flare unit
- Heat Exchange units
- PLC/SCADA units
Summary/Conclusions

1. Breweries can realize significant financial and economic benefits from high-rate AD systems for ww treatment

2. Proper digester system design includes:
   - Wastewater characterization
   - High organic load source capture
   - Unit process selection and design
   - Screening and spent grain disposal
   - Heat exchange design
   - Process monitoring & instrumentation
   - On-line controls
Summary/Conclusions

3. Derived Economic benefits include:
   - Sewer WW surcharge savings
   - Electricity generation
   - Waste heat recovery
   - Renewable Energy Credits

4. Derived Environmental benefits include:
   - Reduce organic waste discharge
   - Generate renewable energy
   - Improve environmental stewardship and community relations
Case Study #2:

Anaerobic Fluidized Bed Digester (AFBD) System for Cheese Plant WW Pre-Treatment and Renewable Energy Generation
Relevant Factors for Cheese Plant WW Pre-Treatment

- Plant WW pre-treatment goals
- Locating and recovering Plant WW
- Targeting high organic loading sources
- Plant cleaning and sanitizing activities
Typical Cheese Plant Chemicals Affecting Anaerobic Digestion

- Cleaning chemicals/CIP
- Sanitizers/Biocides
- Lubricants
- Other Chemicals/Chelating agents
Relevant Factors for Cheese Plant
WW Pre-Treatment

- Required wastewater screening
- Required wastewater equalization and conditioning
- Available space and accessibility
- Optimal system layout
- Operational requirements for Plant AD system
- Maintaining required environmental conditions in Digester system
- Optimizing heat exchange & waste heat recovery
Cheese Plant AFBD System Work Completed

- High-strength WW sampling/characterization
- System sizing and design
- Digester system component fabrication
- System layout and required foot print
- System controls and on-line monitoring
- Project construction
- Digester system start-up/Long-term operation
AFBD System Components for Cheese Plant WW Treatment

- Anaerobic Fluidized Bed Digester units
- Nutrient feed system
- Biogas collection/conditioning system
- Biogas utilization unit (Genset, boiler, etc.)
- Emergency flare unit
- Heat Exchange units
- PLC/SCADA units
- Solids removal/aerobic final polishing
Summary/Conclusions

1. Cheese/Dairy processing plants can realize significant financial and environmental benefits from high-rate AD systems for WW treatment

2. Proper digester system design includes:
   - Wastewater characterization
   - High organic load source capture
   - Unit process selection and design
   - Screening and solids disposal
   - Foaming control
   - Process monitoring & instrumentation
   - On-line controls
Summary/Conclusions

3. Derived Economic benefits include:
   - Sewer WW surcharge savings
   - Electricity generation
   - Renewable Energy Credits

4. Derived Environmental benefits include:
   - Reduce organic waste discharge
   - Generate renewable energy
   - Improve environmental stewardship and community relations
Questions?

Presenter's Contact Information:

Manaf H. Farhan, Ph.D., P.E.
President/CEO
EMG International, LLC
e-mail: Manaf@emgint.com
www.emgint.com