AFBD Technology for Manure Management and Electricity Generation

Description and Advantages

Presented To

Profitability Forum

PA Center For Dairy Excellence

Presented By

Environmental Management Group, International

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Presentation Outline

- EMG Corporate Overview.
- Anaerobic Digestion for Manure Management.
- Currently Available Anaerobic Treatment Systems.
- Comparison of Anaerobic Treatment Technologies.
- Advantages of the Attached-Growth Fluidized-Bed System.
- EMG Point of Contact.

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EMG Corporate Overview

- EMG is an environmental engineering firm that provides a wide variety of services.
  - Solid waste and wastewater treatment technology.
  - Remediation services.
  - Pollution prevention/ wastestream minimization.
  - Regulatory compliance solutions.
  - Environmental audits/permitting.
- EMG specializes in developing and implementing anaerobic digestion systems for waste conversion and energy generation.

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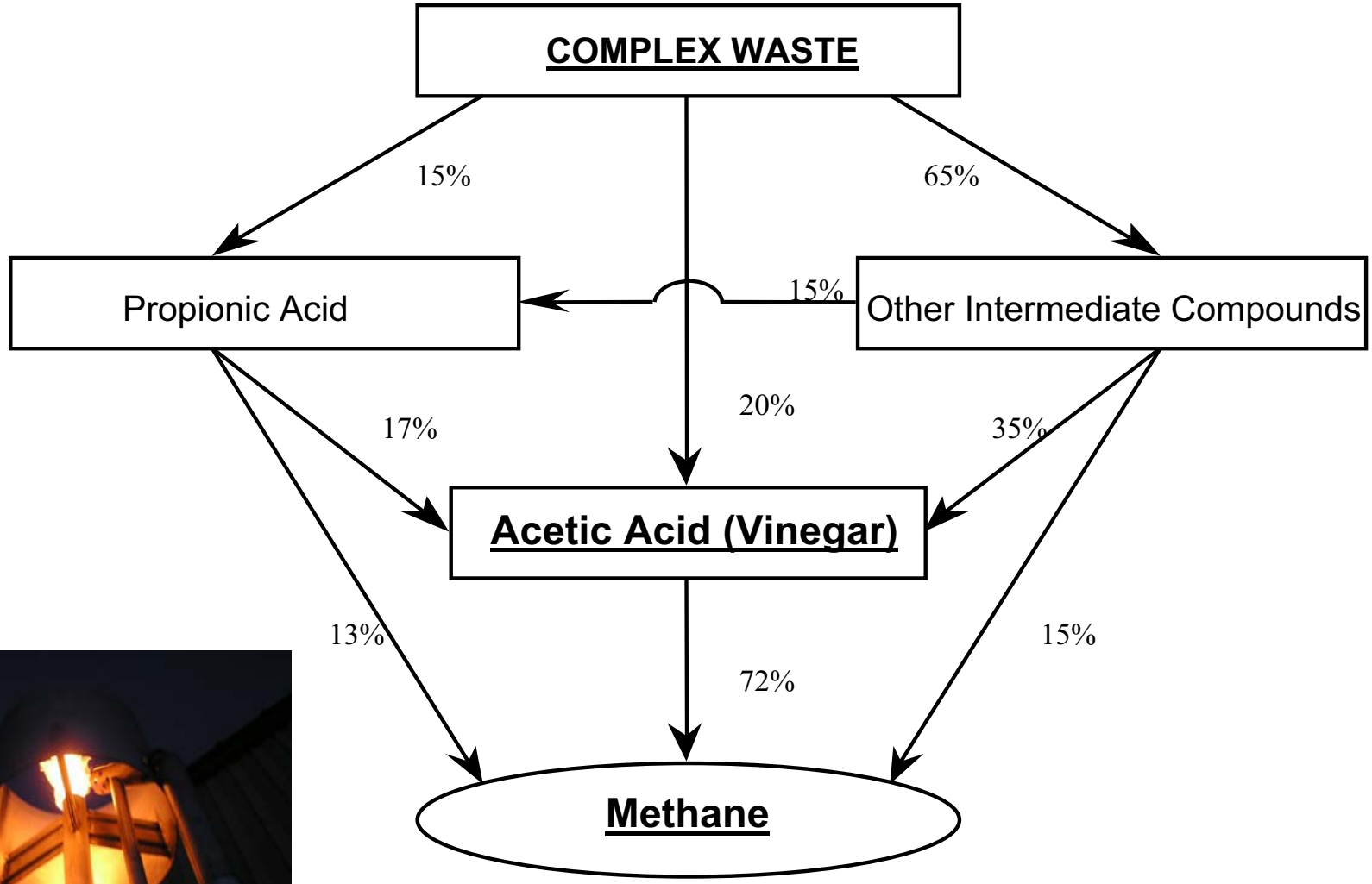
Basic Steps of Manure Digestion



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Anaerobic Technology for Manure Management

- **Advantages**
  - Significantly reduces odors associated with manure disposal.
  - Provide an efficient and reliable source of renewable energy.
  - Provide income/savings to the farm through carbon credits and bedding re-use.
  - Promote farm environmental stewardship.
  - Allows for improved nutrient management at the farm.
- **Disadvantages**
  - Regular process management and control needed.

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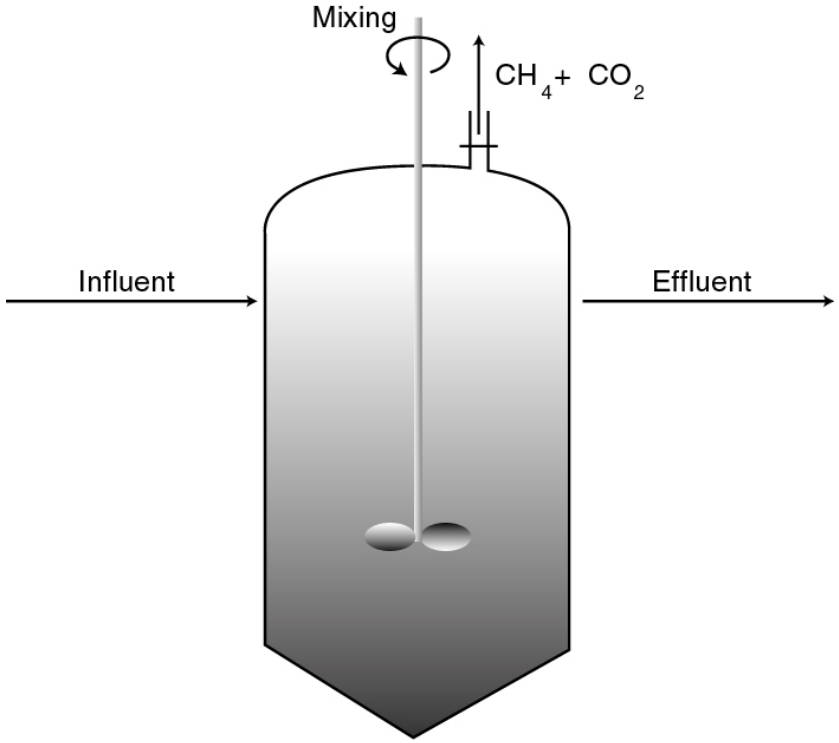
Currently Available Anaerobic Digestion Technologies

- Suspended Growth:

Bacteria remains suspended in liquid during digestion process.



  - Plug-Flow Technology.
  - Completely-mixed Technology.

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Currently Available Anaerobic Digestion Technologies – Cont'd

- Attached Growth:

Bacteria is attached to surfaces during digestion process.

  - Fixed–Bed Technology.
  - Fluidized-Bed Technology.

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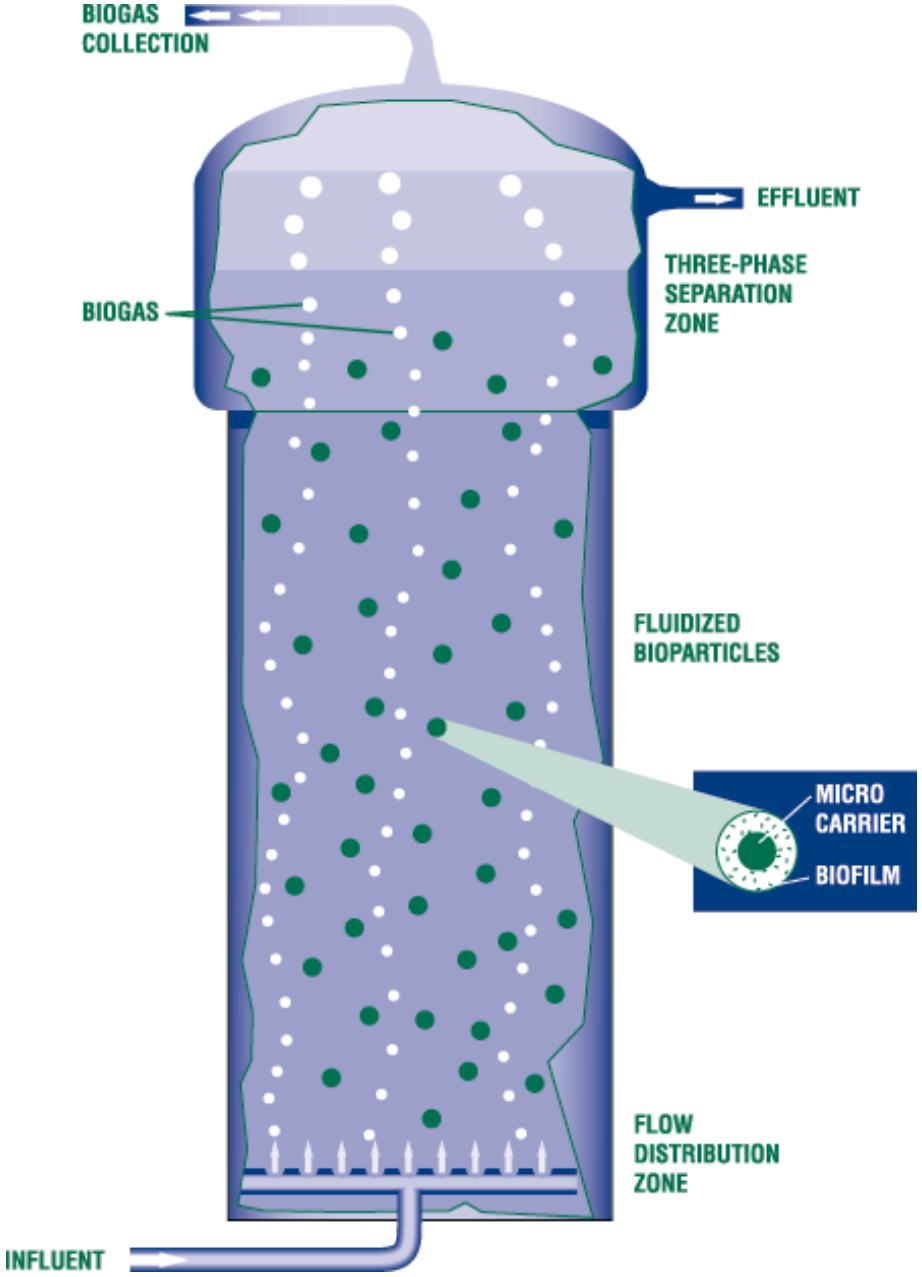
Fluidized-Bed Process Diagram



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Loading Comparison of Selected Anaerobic Digestion Systems

Digester Design	Growth	Loading (lbs. COD /1,000 ft^3/day)	Waste Source	HRT (days)	COD Removal Efficiency (%)
Completely- mixed	Suspended	60-300*	Animal Manure	12-20	80-90
Horizontal plug flow	Suspended	60-300*	Animal Manure	18-22	80-90
Covered first cell of two-cell lagoon	Suspended	60-300*	Animal Manure	30-90	80-90
Upflow sludge blanket	Suspended	700-1,200	Paper Mill (high solids)	2.9	87
Fixed-Bed	Attached	1,500	Paper Mill (high solids)	0.6	72
Fluidized-Bed	Attached	**1,400-3,000**	Paper Mill (high solids)	0.35	88
Fluidized-Bed	Attached	**2,700**	Cheese Whey (high COD)	0.4	80-90
Fluidized-Bed	Attached	**2,200**	Dairy-Cow Waste	0.3	70-80

* Estimated from operational parameters
HRT – Hydraulic Retention Time
COD – Chemical Oxygen Demand

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Comparison of Suspended-Growth vs. Attached-Growth Digesters

Suspended-Growth	Attached-Growth
• Sensitive to variable Load	• Can tolerate variable and shock loading
• Requires large land area	• Has small foot-print
• Solids separation after digestion	• Solids separation before digestion
• Maximum biogas generation	• 10-15% less biogas generation
• Gradual loss of digester capacity over time	• Minimal loss of digester capacity over time

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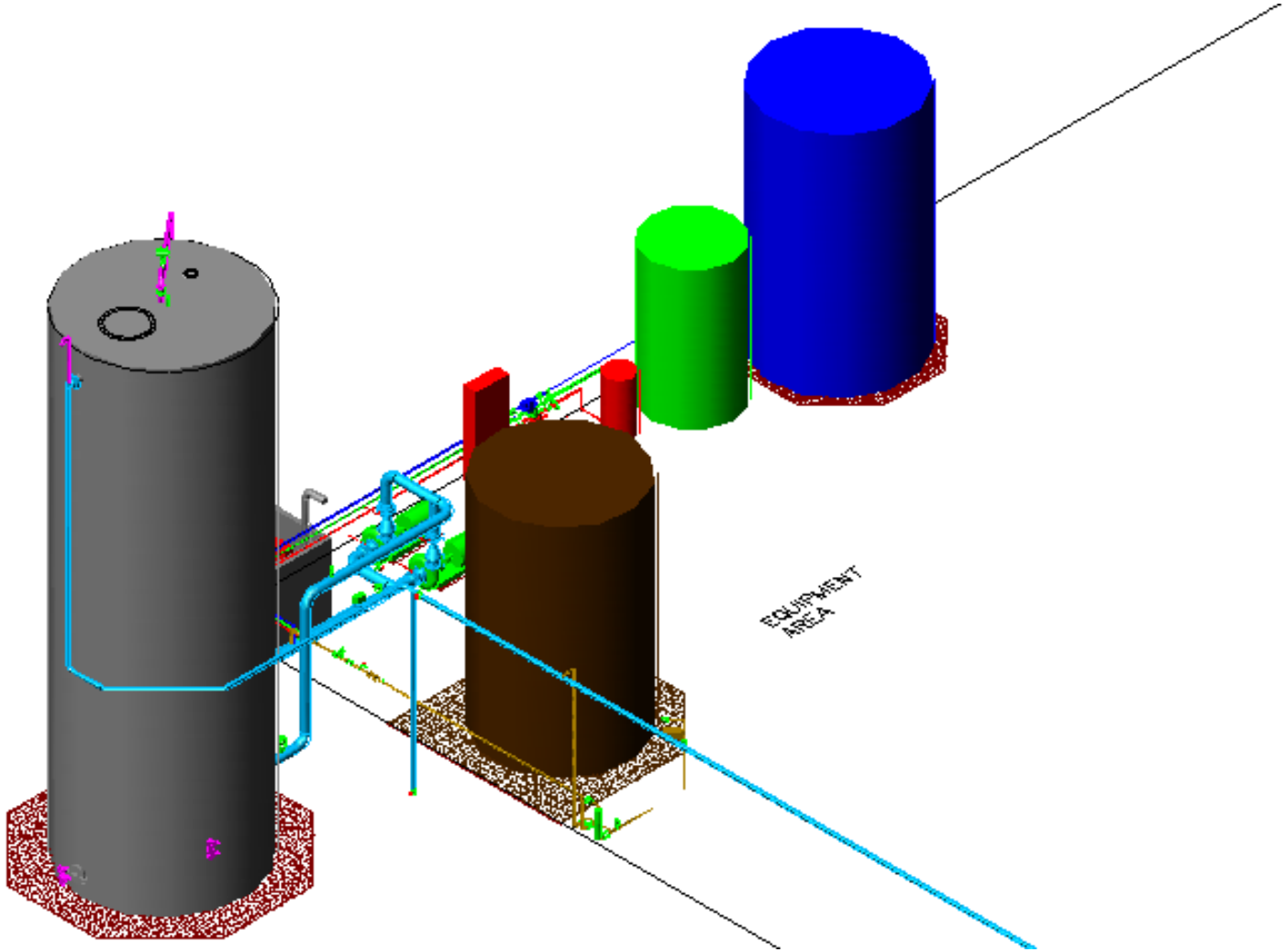
Basic Components of an AFBD System



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Full-Scale AFBD System

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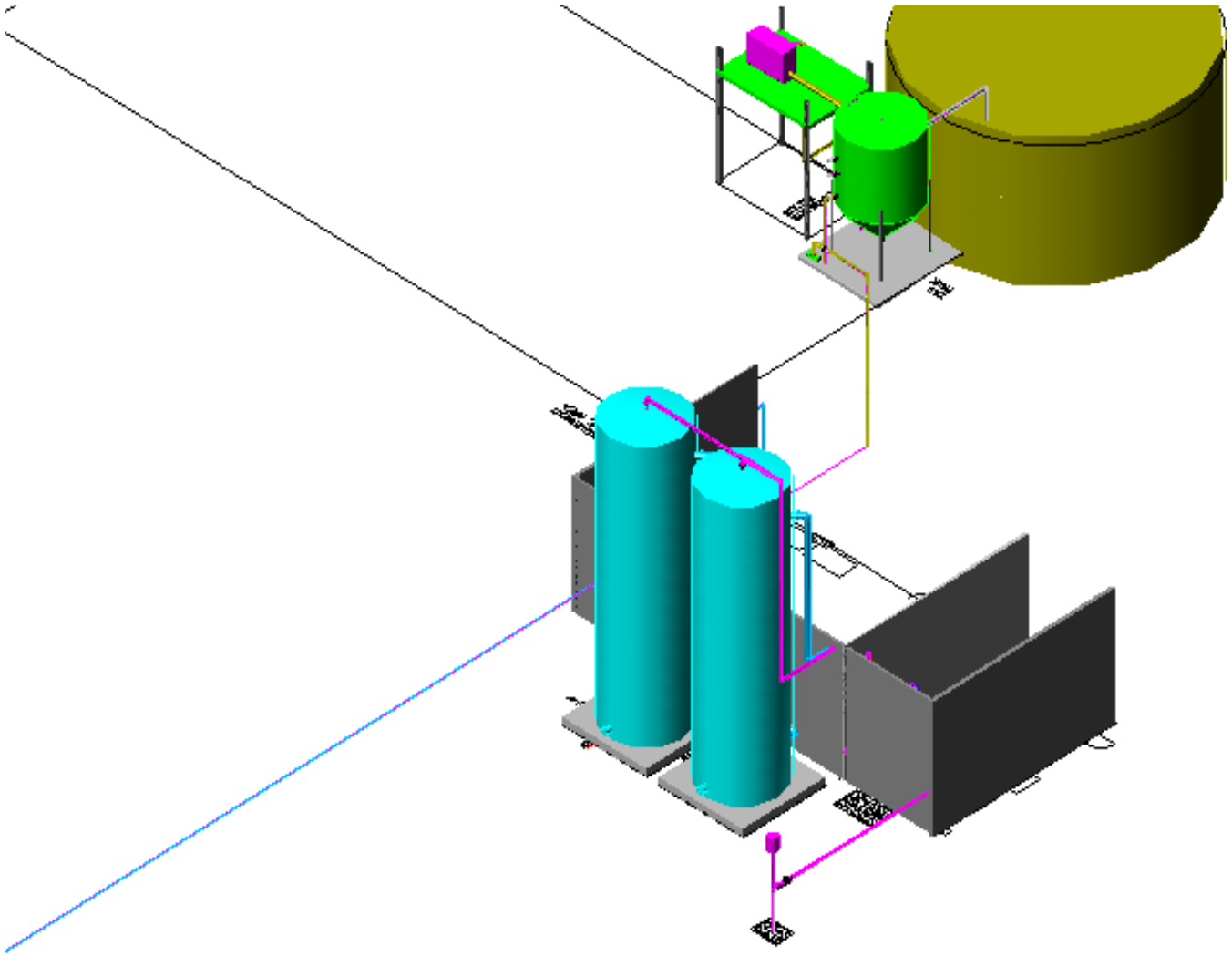
AFBD System For Manure Digestion



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AFBD System For Manure Digestion – Cont'd

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AFBD System For Manure Digestion – Cont'd

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Advantages of the Fluidized-Bed Digester Systems

- **Cost savings**
  - Reduces initial costs due to small tankage requirements.
- **Performance**
  - Highest achievable loading rates (2 to 10 times higher than competing technologies).
  - Minimal footprint and tankage requirements.
  - Enhanced process stability.
  - Proven ability to handle spikes in wastestream volume.
  - Extensive biogas generation and capture.
- **Environmental stewardship**
  - Provides alternative source of clean energy.
  - Enhances farm environmental image and community relations.

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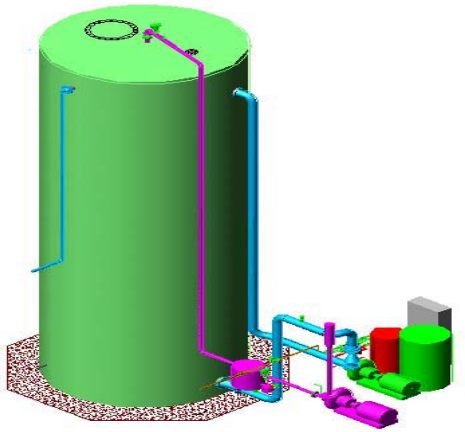
Primary Components of an AFBD System for a 100-Cow Dairy

- ✓ **Day Tank and Separator Unit.**
- ✓ **AFBD Unit with Recirc. System.**
- ✓ **Chemical Feed System.**



- ✓ **System Monitoring and Control Unit.**
- ➢ **Genset for Electricity Generation.**

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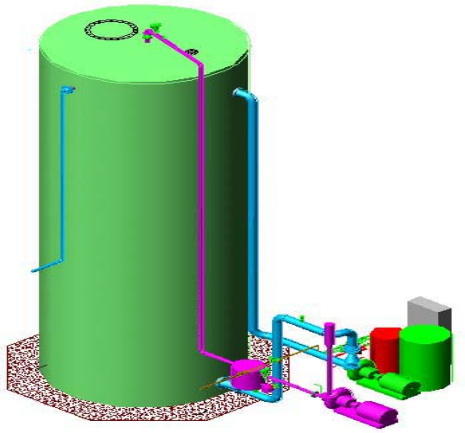
Basic Data Needed for System Design

- Manure Generation Rate
- Organic concentrations:
  - Average BOD_5 of waste whey
  - Average COD of waste whey
- Suspended solids concentration.



- Annual costs of electric usage and manure management.

BOD_5: five-day Biochemical Oxygen Demand
COD: Chemical Oxygen Demand

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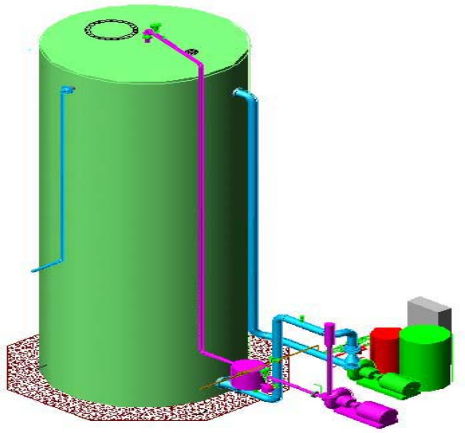
Economic Parameters for an AFBD System at a 100-cow Dairy



- **Costs and Effort**
  - System capital cost
  - Area requirements ~ 250 ft^2
  - 8x8 tank pad.
  - Daily system checks with weekly/monthly maintenance.
- **Benefits**
  - Electricity generated ~ 250 KW-H per day ($9,500 to $13,000 per year).
  - Solids generated ~ 1,200 lbs. per day.
  - Carbon credits ~ $30,000 lump sum payment ($1,500/year for 20 years).
- **Partial Funding Often Available From PA DEP, PEDA, USDA, and Others.**

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EMG Point of Contact

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