On-Farm Anaerobic Digestion in the United States

Energy & Climate Partnership of the Americas
MSU/UCR Kickoff Seminar
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U.S. On-Farm Anaerobic Digesters

176 On-Farm Systems

Green Meadow Farms

Common Anaerobic Digesters Types

- **Covered Lagoon**
- **Plug Flow**
- **Complete Mix**
- **Complete Mix**
Green Meadow Farms, Inc (GMF)

- Founded in 1922
- 3rd generation family farm
- Farm statistics
  - 7,500 animals
  - 2,630 hectares of cropland
  - 2 milking parlors
- Approximately 70 employees
- First operated an anaerobic digester in 1980
  - Plug flow digester
  - Operated for 6 years
  - Shut down due to mechanical issues
Green Meadow Farms, Inc

2,000 Milk Cows

1,200 Milk Cows

Anaerobic Digester
GMF Anaerobic Digester

- Broke ground in 2006
  - Completed 2007
  - Financial support from Michigan Public Service Commission
  - Design flow rate 475 m$^3$/d (472 metric ton/day)

- Complete mix (3 tanks)
  - Capacity of 10,220 m$^3$ (3,400 m$^3$ per tank)
  - 22 to 26 day hydraulic retention time
  - Propeller style mixers (3 per tank)

- On-farm digester feedstock manure (2,900 milk & 300 dry cows)

- Off-farm digester feedstock
  - Ethanol byproducts (syrup)
  - Vegetable processing waste
  - Salad dressing wastewater
GMF Anaerobic Digester - construction
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GMF Anaerobic Digester – construction
• Biogas used for electrical production
  ▪ Caterpillar® 3516 engine-generator with heat recovery
    ♦ 800 kW electrical output potential
    ♦ All electrical energy sold off farm
  ▪ Heat recovery
    ♦ Hot water to sludge
    ♦ In wall & floor heat

• Digestate use
  ▪ Fertilizer for crops
  ▪ Compost
GMF Anaerobic Digester - products

Engine-generator

Compost

Engine-generator

Digestate irrigation
Conclusions

- Successfully system
- Minor mechanical issues
  - Metal fatigue
  - Roof material
  - Corrosion
- One biological upset during first 5 years
- Off-farm feedstocks change over time
- Expansion still being considered
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