Swine Manure Digester at Pine Hurst Acres – A Preliminary Report

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Crone Farm - Background

- 2 buildings
- Each with a holding capacity of 2,180 finishing hogs
- Populated for the first time – Fall 2002
Large-pen Finishers

Each building has 4 large pens
About 500 hogs/pen
Some advantages of this type of building

- All manure storage is under the building
- Less odor from storage
- Lower capital costs and maintenance of penning
- Less social contention (pigs and people)
- Feed formulation based on weight
- Lower labor costs/time savings
- Sorting premiums optimize income
New finishing system –
new digester ideas

The new one-room self-sorting type swine finishing building is being used.
Habits in the large room

- Food court causes patterned pig movement
- Hogs like to lie along the walls of the large room

Empty food court

Hogs rest along walls
Just like home…

BEDROOM

KITCHEN

HALLWAY

RESTROOM ??
Dunging Pattern

A dunging pattern emerges in large pens and a majority of manure is deposited in the central corridor of the large pens, where it falls into deep manure pit storage below the slatted floor.
Hogs in the large-pen sorting rooms are creatures of habit...

Can this dunging pattern be used to make anaerobic digestion at a swine finisher more economic?
Crone Manure Pits - Reconfigured

1,100 pigs

Raw Manure

Digested Manure
Under floor pit schematic

- Raw Manure
- Digested Manure

To digester

From digester
Manure deposition in reconfigured deep pits has been measured 78% of raw manure is deposited into collection pits.
78% of manure goes to the right place

Raw Manure pits receive 78% of raw manure

Digested Manure pits receive 22% of raw manure
Typical Digester

- Biogas
- Digester
- Storage
- Electric Generation
- Land Application (Reduced Odor)
Crone Digester – no construction of post-digestion storage

Post-digested manure to be stored under the building

Land Application

Digester
Schematic – site layout

Manure flow **to** digester

Manure flow **from** digester

2 finisher buildings – 4,400 total head

Digester
Manure flow to digester
Manure flow from digester

1,100 pigs

1,100 pigs
Round concrete digester design

First chamber - complete mix

Second chamber – complete mix with return to first chamber
Round concrete digester design

28 day retention time will allow very complete digestion

Mesopholic = 95 degree F
Manure flow

- Manure pumped to digester 8 times daily (every 3 hours)
- Manure gravity flows back to deep pits
- Inside the buildings the pits are all connected with safety overflows
- It is possible to empty all pits through pump out locations
Pump outs
The digester today
Crone Digester
Why does anaerobic digestion offer lower odors?

Complete anaerobic digestion (oxygen free) reduces odor in three steps.

1. Liquefying (hydrolitic) bacteria convert insoluble, fibrous materials into soluble substances
2. Acid-forming bacteria (acetogens) break down these organic compounds into simple organic acids
3. Methane-forming bacteria (methanogens) produce biogas and low odor effluent
Other benefits of digestion

- Better use of energy
- Manure to methane, methane to methanol, methanol to biodiesel
- Phosphorus – possible transport of separation
- Reduce pathogens/virus; seeds
- GHG reduction/acid rain benefit
- Tax credits
- Sale of power
Traditionally cost prohibitive

- Built to make electricity, digesters have traditionally cost more to install than the electric savings and income that they offer.
- They just don’t make economic sense.

- However, today’s new farms have increased environmental and social costs that may help justify their adaptation.
- Government policy may become favorable.
- Utility policy may become favorable.
Other traditional roadblocks

- Power grid operators that are not cooperative
- Low buy-back rates from power companies
- It takes a committed manager
- It wasn’t as necessary as it is now
- Lack of government funding
Makin’ more than bacon

- 14,000 cu. ft. biogas daily
- 550 KWH/day
  - Daily average is rarely exceeded
- $875 average electric bill
- Biogas content
  - 68% Methane
  - 30% Carbon Dioxide
- Chicago Climate Exchange Carbon Credit – 1st in PA
Swine living area concerns

- Concerns with reintroducing digested manure beneath the slatted floors of the hog houses
  - Air quality within the living area
  - Animal welfare and production concerns
- Monitoring inside the buildings will indicate if problems exist
  - $\text{CH}_4$
  - $\text{H}_2\text{S}$
  - $\text{NH}_3$
Living Area Gas Solutions?

- Alternative technologies may need to be employed
- NC digester uses an aerobic biofilter to convert ammonia N to other forms of N
Penn State research...

Preliminary monitoring of air quality indicates that gas levels in the barn are not elevated to harmful levels with the introduction of post-digested manure.
It appears to me that...

- ...society demands environmental advances.
- ...farm level energy production advances this cause.
- ...changes are needed for acceptance of farm-level electric production.
- ...positive environmental effects should be rewarded with grid acceptance and fair-priced net metering.
- ...farm-level energy production will advance.
Net Metering

- Someone has to pay
  - Consumer vs. Tax payer

- For example: Crone Digester Funding
  - PDA $75,000
  - DEP $10,000
  - PA Pork Council $5,000
  - Sustainable Energy Fund $15,000
  - Wenger Feeds $30,000

$135,000
Pennsylvania has enacted an Alternative Energy Portfolio Standard

Utilities will need to produce 18% of their electric energy through alternative sources by 2020.
Pennsylvania Utility Update

- Farm-level net metering is being implemented in early 2007.
  - All farm meters at within a 2 mile radius of energy source can be lumped together.
  - Incoming electric purchased at retail rate.
  - Outgoing electric purchased at wholesale rate.
  - Net metering allows a balance across all meters that is calculated at retail price.
Digestion Project at Crone Farm

Summary

- New manure flow pattern may make digestion more feasible.
- 78% raw manure to designated collection pits.
- Animal housing air concerns merit monitoring.
- Utility contracts are difficult.
- Please support farm-level energy production.
Questions?

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