Dairy Facility Siting and Technologies for Mitigating Emissions on Midwest Dairies

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Siting of Dairy Facilities

Question: Is odor the main practical air quality concern for a dairy farm?
Response: If yes, then address that concern.
• Odor is:
  ▪ Challenging to control
  ▪ A local/neighbor issue
  ▪ Especially problematic for new facilities
• A big part of the solution:
  ▪ Manage what is local and who are neighbors

Siting for Reduced Odor Risk: Planning Tools

• Advance planning may be required
  ▪ State rule
  ▪ County or township ordinance
• Advance planning is beneficial
  ▪ Identify concerns
  ▪ Identify siting options
  ▪ Assess potential of mitigation strategies
  ▪ Possible plus for getting approval

Dairy Siting Dilemma: Contradictory Rural Community Acceptance

Wisconsin Dairy Family Wins Siting Case
Posted on July 16, 2012

On July 11th, a Wisconsin dairy farm family... won a major victory for concentrated animal feeding operations (CAFO) producers. The Wisconsin Supreme Court sided with the family against the town of... concluding that the town cannot set pollution control measures for sitting or expanding a CAFO that are more strict than those measures laid out by the Wisconsin Legislature.


State vs. Local Rule

• In WI, state rules rule for air & water quality

Wisconsin Dairy Facility Wins Siting Case

In other states (e.g. MN, NE and SD), local zoning may govern odor
**Dairy Siting Dilemmas**

- Contradictory rural community acceptance
  - Livestock expansion is often accepted where capacity is pressed and opposed where it may be most beneficial
- Response to odor varies
  - Sensitivity
  - Offensiveness

While 'minimum separation' may be prescribed, 'acceptable' separation is relative to the recipient.

**Use Available Planning Tools**

- Actively address local environment
- Good way to mitigate 'odor problem'
- Options:
  - OFFSET
    - [http://www.extension.umn.edu/distribution/livestocksystems/DI7680.html](http://www.extension.umn.edu/distribution/livestocksystems/DI7680.html)
  - WI Odor Standard (derived from OFFSET)
  - Odor Footprint Tools (offspring of OFFSET)
    - NOFT [http://water.unl.edu/web/manure/odor-footprint-tool](http://water.unl.edu/web/manure/odor-footprint-tool)
    - SDOFT [http://www.sdstate.edu/abe/research/structures/upload/SDOFT.pdf](http://www.sdstate.edu/abe/research/structures/upload/SDOFT.pdf)
    - Multi-Source Odor Setback Model
      - [https://engineering.purdue.edu/~odor/setback.htm](https://engineering.purdue.edu/~odor/setback.htm)

**Air Pollution Control Points**

- Prevent generation
- Capture or destroy before releasing to the atmosphere
- Disperse or disguise to mitigate impact

**Reducing Generation: Dietary Manipulation**

- Balance ration (a BMP)
  - Limit excess protein → Limit NH₃ emissions
- Monensin → Improved feed efficiency
  - Anticipate that less manure → less methane and possibly less odor
- Variety of products and claims
  - Evidence for odor reduction?
  - Primary effects and cost?

**Reducing Generation: Solids Separation and Reduction**

Objective: Remove volatile organics and nutrients
- Mechanical separation alone → ~30% Max. reduction
  - Challenge is removing dissolved solids
- Study by Harrison and Whitefield, 2012
- Polymer addition (e.g. ferric chloride) can substantially improve solids reduction
  - Coagulant usage can become extensive and expensive

**Reducing Generation: Anaerobic Digester**

Objective: Break down organic matter → biogas
- Digester effluent has:
  - Less odor-generating potential (60 to 80% reduction)
  - Greenhouse gas reduction CH₄ → CO₂
  - Higher NH₄ content → higher potential ammonia loss
- Digester biogas contains hydrogen sulfide
  - Odor from leaks in cover or S-removal process?
Reducing Generation: Wastewater treatment

Objective: Break down solids w/o/odor emissions

- **Low-tech:** Treatment lagoons
  - Less odorous than storage basin
  - Larger facility and management required
  - Less effective in cold climates
  - Seasonal odor bursts (spring turnover)
  - High NH₃ and N losses

- **High-tech:** Municipal treatment systems
  - Can clean-up wastewater w/little odor
  - Manure requires pre-treatment for solids reduction
  - Large capital and operating cost

Reducing Generation: Aeration

Objective: Break-down organics aerobically

- **Aerobic emissions**
  - Very little odor
  - Less undesired gas emissions (e.g. CH₄, NH₃)

- **Conventional systems have high cost and power demand**
  - Typical installation
    - Under capacity (size & # units)
    - More a show of effort
  - Liquid-circulation systems show more promise
    - Treatment must be continual

Reducing Generation: Manure Additives

Objective: Alter bioactivity for reduced emissions

- Have often underachieved
  - Limited effectiveness
  - Costly to implement over time
  - Side effects (e.g. pH swings)
- **May enhance solids breakdown**
  - Easier manure handling
  - Longer-term emission benefits
- **May be effective for certain circumstances**
  - Producer testimonials
  - May have limited initial/trial investment cost

Reducing Generation: Composting

Objective: Aerobically break down organic matter

- Emissions [compared to stock-piling]
  - Less odor and less-offensive odor
  - May lose more NH₃ and N

- **Management concerns [vs. stock-piling]**
  - Additional equipment and labor needs
  - Significant volume reduction
  - Greater acceptance / market potential

Capturing & Destroying Gases: Permeable Covers

Objective: Reduce emission rate of odor

- Slow air exchange at manure surface
- Break down gases within cover media
- Can provide >50% odor reduction
- Biocovers (thick straw layer)
  - Low capital cost
  - Maintenance issues and cost
- Geotextile covers
  - Higher up-front cost
  - Durability has improved

Capturing & Destroying Gases: Impermeable Covers

Objective: Seal off surface to eliminate emissions

- Can provide 90% odor reduction
- Gas buildup
  - Typically flared
  - May be combusted for heat or power supply [covered-lagoon digester]
- High initial cost
- Maintenance needs
  - Pumping out
  - Repairs
Capturing & Destroying Gases: Biofilters

Objective: Microbes consume odorous gases
- Can provide 90% odor reduction of treated air
  - Most farm systems don’t treat all of the airflow

Mitigating Impact of Emissions: Vegetative Environmental Buffers

Objective: Divert and dilute odorous air
- Vertical barriers deflect and help disperse odors
  - Not suited to dairy barns
  - Height & fan limitations
  - Negligible emission effect

  VEB use trees for windbreak and filtering
  - Natural windbreak
  - Shelterbelt

Summary

- Good siting of facilities can alleviate many potential odor challenges
  - Understand your locale
  - Use available planning tools

  Technologies exist for mitigating emissions
  - What is needed: emission reduction or addressing concerns of a few residents?
  - All have costs and management concerns
  - Consider expected benefits and costs

Air Quality in Animal Agriculture

- Webcasts
- Videos
- Fact sheets
- Photos
- Web links
- Other environmental resources