Best Management Practices for Reducing Odor & Emissions on Midwest Dairies

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Air Quality Issues for Dairies

- Odor
  - A real concern for most producers
- Ammonia
  - An imminent concern for many producers
- Greenhouse gases (GHG)
  - A growing concern / opportunity for some producers
- Other gases and dust
  - A potential concern for a few producers

Why manage odor?

Today's realities:

- Every dairy produces odor
  - Smells like?  How often?  For whom?  ??
- Odors may evoke complaints and complaints can be bad news for business
  - Communication divide with neighbors
  - Draw unwanted attention and scrutiny
  - Potential for litigation
  - Distraction for management of dairy

Why manage ammonia (NH₃) emissions?

- Growing environmental concern
  - Chesapeake Bay, nutrient loading
  - Reactive N, fine particulates (PM₂.₅)
- Expanding reach of regulations
  - Enforcement of EPCRA reporting
  - Role of Clean Air Act??
- Significant loss of nitrogen
  - Fertilizer value
Concern about Reactive N

While air consists of mostly N₂ gas, other forms of N in the atmosphere (e.g. NO, NO₂, N₂O) are being assigned negative environmental impacts.

Example:
- Health studies have shown a significant association between exposure to fine particles and premature death from heart or lung disease.
- PM is a regulated criteria pollutant
- NH₄NO₃ is a common fine particulate in agro-industrial areas
- NOₓ (nitrogen oxides) is a regulated criteria pollutant. Power plants, automobiles, and other combustion sources emit NOₓ.
- Farms emit ammonia (NH₃), a PM₂.₅ 'precursor'.

Source: www.epa.gov

Why manage GHG emissions?
Dealing with misperception & uncertainty

<table>
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<tr>
<th>Issue</th>
<th>Perception or feared outcome</th>
<th>Reality now or likely outcome</th>
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| Regulation of Ag emissions | • EPA regulation via CAA  
• New state policy (e.g. CA)  
• Congress pass a 'cow tax' | • EPA reporting rule on books for >3,200 cows  
• Lack legislative support |
| Consumer demand & milk market | • 'Green' consumers want low-carbon-footprint food  
• Barrier for market growth | • Lag in willingness to pay (consumer & retailer)  
• Niche → market-wide |
| Methane capture and market | • Profit from carbon credits or producing bioenergy  
• Digesters will be required | • No/poor U.S. market for carbon credits / biogas  
• Digesters in select cases |
| Role of U.S. Animal Ag | • Leading GHG emitter  
• Bear large burden of reducing emissions | • Relatively minor source of U.S. GHG emissions  
• A model for efficiency |

Why manage GHG emissions?
What will drive markets and policy?

Source: EPA GHG Inventory, 2008
**Results after BMPs for Odor**

<table>
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<tr>
<th>Management Category</th>
<th>Odor</th>
<th>Particulate Matter (OM)</th>
<th>Ammonia (NH3)</th>
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<td>Land Application</td>
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<td>Perceptions</td>
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</tbody>
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**Manure Injection**

*Can conserve 90% of N value*

- **Tank wagon**
  - (1,500–10,000 gal)
  - How fast can/must manure be applied?
  - More compaction, but tillage benefits
  - ↓ Odor, ↓ NH3, ↓ H2S
  - Also reduces runoff

- **Hose-drag injector**
  - (900,000 gal/day)
  - Minimize throwing and splashing

**Priority #1 - Land Application**

- **Odor hot button**
  - Strong eye-nose-brain connection
  - Acute, intense emissions
  - Proximity concerns
  - Perceived lack of control
- **Gas emission spike**
  - NH3 loss

**Manure Incorporation**

*Effective emissions reduction when done promptly (< 24 hours)*

(WDNR NR 243, <48 hr)

**Land Application AQ BMP**

- **Get it below**
- **Keep it low**
- **Think about how the wind will blow**
- **Manage how your neighbors know**

**Subsurface Agitation**

*Minimize throwing and splashing*

- **Do**
- **Don’t**

Photos by: C. Fulhage
Keep a Low Profile

Less drift and attention
• Maximize droplet size
  – Large nozzles
  – Low pressures
• Control spray distance
  – Little or no upward spray
• Spray within the canopy or close to the ground
  ↓ Odor, ↓ NH₃, - H₂S, ↓ Drift

Dairy Facilities

• Baseline emission sources (24-7-365)
  – Source of chronic odor complaints
  – Regulatory control and action most likely
• Dairy herd management tends to:
  – Limit cattle areas as odor emission sources
  – Shift emissions to manure storage & handling

How the wind blows...

• Monitor weather forecast
  – Esp. wind direction and speed
  – Who / what is likely downwind of application area?
• Avoid calm days and dusk/dawn application for manure application
  – Odor plume stays concentrated and near the ground
• Avoid windy days for irrigation
  – Don’t irrigate if wind >10 mph

Feed Mgt. - Balance Rations

• Overfeeding protein → NH₃ emissions
  – Use multiple rations
  – Test feeds regularly
  – Balance for metabolizable protein
  – Manage byproduct use (distillers grains, etc.)

How do neighbors know?

• Communicate with them ahead of time
  – Convey appreciation of their interests
    • Neighbor activities?
  – Convey your efforts to minimize impacts
• Limit sensory effects
  – Property line windbreaks (vegetative buffers)
    • Visual and olfactory benefits
  – Limit use of public roads and tracking
  – Turn off or remove end-guns on pivots

Feed Management

• Manage feed for less shrink and wastage
  – Good cover and seal
  – Manage bunker face [exposure]
• Manage feed bunks and water tanks
  – Clean bunks and tanks regularly
  – Limit unintended wetting of feed
  – Limit water spillage / promptly fix leaks
**Barn Practices**

- BMP for odor and gases are same as for cow cleanliness and mastitis control
  - Clean
  - Dry
  - Comfortable

**Storage BMP – Liquid Manure**

- Maintain/enhance solids removal
  - Maintain mechanical separators
  - Clean out settling basins regularly
  - Clean out storage basins fully
  - Manage manure treatment system

  OR

- Maintain crust as natural cover

**Manure Collection**

- Consider effects of cleaning frequency
  - Scrape systems
    - More often is better for odor
    - Less often may be better for ammonia emissions
  - Flush systems
    - More often is generally better
    - Depends upon quality of flush water (burst emissions)

- Maintain cleaning effectiveness

**Storage BMP – Solid Manure**

- Limit moisture addition (keep high & dry)
- Helps control odor, ammonia loss & flies
  - Divert clean runoff
  - Divert precipitation
  - Drain off seepage

- Partial compost
  - Benefit for odor control
  - May increase NH3 loss

**Manure Transfer to Storage**

- Load into storage below surface
- Use closed pipe or conduit

Minimize exposure to air [and eyes]

**Summary**

- Odor and ammonia emissions likely key
- Land application can invite trouble
  - Immediate incorporation ➔ less emissions
  - Don’t ignore the power of communication and perception
- Facility emissions may become challenge
  - Reducing emissions probably means managing manure better or differently
  - Managing manure emissions may entail inconvenience, cost, complexity, etc.