Mitigating Emissions from Dairy Housing

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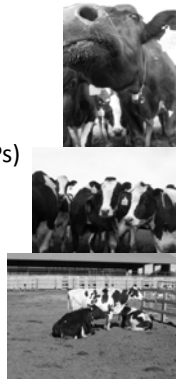
Western Dairy Air Quality Symposium
April 16, 2009

Outline

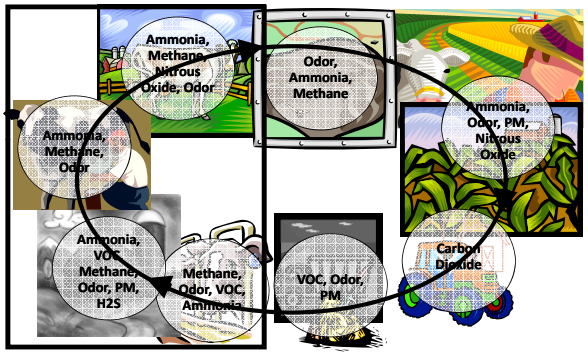
- Major atmospheric pollutants from dairy housing
- Sources of Emissions
- Best Management Practices (BMPs)
- Disclaimer
- BMPs for Dairy Housing
- Future Considerations
- Questions



Emissions from Dairy Housing

- Ammonia (NH_3)
- Odor
- Volatile Organic Compounds (VOC's)
- Green House Gases:
  - Methane (CH_4), Carbon Dioxide (CO_2)
- Particulate Matter (PM)
- Hydrogen Sulfide (H_2S)

Sources of Emissions



Estimated Contributions of Total Budgets from Housing

- Ammonia – 30-70% (freestall), 30-60% (drylot)
- Odor - Variable
- Volatile Organic Compounds – up to 70% (freestall), 90% (drylot)
- Green House Gases:
  - Methane – up to 75% (eructation, flatulation)
  - Carbon Dioxide - <1%
- Particulate Matter (PM) – ~20% (freestall), up to 90% (drylot)
- Hydrogen Sulfide (H_2S) – minimal freestall, 5 -20% (drylot)

Best Management Practices (BMP)

- BMPs: Practices designed to prevent or reduce the negative impacts of airborne pollutants, while maintaining or improving animal performance

BMPs should be:

- Effective
- Economical
- Practical
- Easy to install and maintain

Disclaimer

- **It is important to note that not all BMPs are viable on every operation. BMPs must be selected individually for an operation based on current management practices, BMPs already in place, operation layout, economics, and ammonia reduction goals. Additionally, the BMP with the most proven potential for ammonia reduction might not exhibit the same results on every operation. BMPs should be chosen wisely and monitored for effectiveness on a continuous basis.**

Freestall Housing BMPs

- Diet
  - Crude protein (N), digestibility (methane)
- Manure Removal Technology
  - Scrape, automated scrapers, vacuum, flush
- Manure Removal Rate
- Bedding Type
  - Sand, wood product, compost
- Composting Dairy Barns
- Ventilation Rate
- Heat Management
  - Water sprinklers

Manure Removal Technology

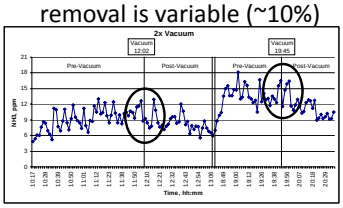
Ammonia, VOC, Odor

- Technology:
  - Driven Scrape
  - Automatic Scrape
  - Vacuum
  - Flush
- Increasing surface area of manure increases ammonia
- Effectiveness is very dependent on efficiency of removal

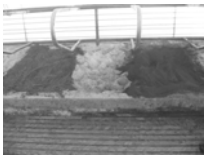
Manure Removal Frequency

Ammonia, VOC, Odor

- Spike in ammonia after removal (scrape systems)
- Emission decrease after removal is variable (~10%)



Bedding



Ammonia, Odor

Common bedding types:

- Sand has lowest emissions when fresh (2-4 ppm), otherwise ammonia can be very high (20 ppm)
  - Minimal cow health issues
- Compost has very consistent emissions (4-5 ppm), must be properly managed to maintain aeration
  - 43% lower emission that sand over 30 days
  - Minimal issues with cow health noted
- Wood emissions can be very high (20 ppm)
  - Poor cow health (moist)

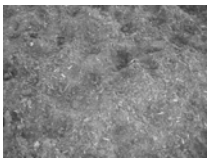
Drylot Housing BMPs

- Diet
  - Crude protein (N), digestibility (methane)
- Harrow in Bedding
- Pen Moisture Rate
- Surface Additives
- Bedding
- Shade
- Harrow Timing
  - Rate, time of day
- Pasture Management

Harrow in Woodchips

Ammonia, Odor

- Harrow woodchips into pen surface
- Can decreases ammonia by 40%
- Aerates and encourages composting of the top layer
- Minimal odor



Pen Moisture

Dust, Odor, Ammonia

- Balance dust and odor with moisture (24% moisture)
  - ↑ Moisture = ↑ Odor; ↓ Moisture = ↑ Dust
- Saturated areas can encourage ammonia emissions upon evaporation
- Sprinkling should be confined to high dust times (late day)

Surface Additives - Alum

Ammonia

- Just after application:
  - Liquid ↓ NH3 by ~56%
  - Granular ↓ NH3 by ~48%
- After two days, ammonia levels were near or above baseline
- Application of alum was very difficult, *expensive*, and time intensive
- In literature, alum is said to reduce ammonia emission by up to 95% for up to 2 weeks

Drylot Bedding

Ammonia, Odor, Moisture

- Separates urine and feces
- Discourages ammonia production
- Bedding used in compost

Shade

Ammonia, Dust

- Decreases heat stress
- Help spread out manure
- Manipulate pen usage

BMP Considerations

- Temperature
  - Emission tend to increase with increasing temperature
- Moisture
  - Precipitation and relative humidity
- Season
  - Emissions can be higher in the summer (dry and hot)
- Time of Day (diurnal flux)
  - Activity level of cows, inversions, temperature flux,
- Wind Speed and Direction
  - Velocity that emission are carried away from surface

BMP Future Considerations

- Need for BMPs is increasing
- Dairy industry is in a tough financial time
- More research needs to be focused on field proven, practical and economical solutions
- Need more proactive participation and voluntary change