Manure Management and Air Quality
Manure Management

• Q: What is the best manure management system?

• A: A well-managed one
Manure Management

- Each manure management system has its own positives and negatives
- In any system, though, work and effort are involved to make them effective for AQ
General Manure Management

• Keep things simple
  – Keep dry stuff dry and wet stuff wet
  – Prevent/clean up spills
General Manure Management

• Feed management
  – What goes in has to come out
    • Manage N and S in feed, water, and additives
  – More efficient feed utilization means more in the animal and less in the manure

• The same concept applies to nutrient management for land application
Manure Management for AQ

• Beyond feed management, there are other “pressure points” where we can make an impact on air emissions
• 3 main processes we can influence
  – Formation/generation
  – Release/emission
  – Transport/dispersion
Formation/Generation

- Think in terms of the type of manure management system
  - Solid vs. liquid/slurry
  - Aerobic vs. anaerobic
- Also, consider other parameters within the system
  - Temperature, pH, etc.
Solid Systems

- Typically aerobic
  - May have anaerobic pockets, if moisture content is too high
- Carbon volatilizes mainly to CO$_2$ or stays solid
  - Some VOCs and CH$_4$ if not completely aerobic
  - Some carbonaceous PM
Solid Systems (cont.)

- Nitrogen volatilizes mainly to $N_2$ or stays as $NH_4^+$ or $NO_3^-$
  - Can produce ammonia, depending on other properties
  - Can produce $NO_x$ and $N_2O$, if there are wet areas in the dry material
- Sulfur will typically not volatilize
  - Some odorous sulfur formation in anaerobic/wet pockets
Liquid/Slurry Systems

- Can be aerobic or anaerobic
  - Aerobic liquid/slurry systems usually require large energy input
- Carbon volatilizes mainly to CO$_2$ (aerobic) or CH$_4$ (anaerobic) or stays solid
  - VOCs can be formed if not completely aerobic or completely anaerobic
  - Higher moisture content can keep most VOCs in solution
Liquid/Slurry Systems (cont.)

- Nitrogen volatilizes mainly to N$_2$ or stays as NH$_4^+$ or NO$_3^-$
  - Can produce ammonia, depending on other properties
    - Higher moisture content can keep most ammonia in solution
  - Can produce some NO$_x$ and N$_2$O
- Sulfur will volatilize to odorous sulfur compounds in anaerobic systems or in anaerobic pockets
Formation/Generation (cont.)

- Manure management techniques for formation/generation are often in conflict
  - High moisture content can lower PM emissions and keep VOCs and ammonia in solution, but promotes odorous sulfur compound and methane formation
  - High pH will lower odorous sulfur compound formation potential, but increase ammonia formation potential
Practices/Activities for Formation/Generation

• Feed management (592)
• Nutrient management (590)
• Solid/liquid waste separation facility (632)
• Anaerobic digester (365, 366)
• Amendments for the treatment of agricultural waste (591)
• Composting facility (317)
• Waste treatment (629)
• Waste treatment lagoon (359)
• Waste storage facility (313)
• Waste utilization (633)
• Waste facility cover (367)
Release/Emission

- Independent of system type
- Consider the parameters discussed earlier
  - Concentration of generated pollutant(s)
  - Temperature
  - pH
  - Moisture
  - Air movement
  - Etc.
Practices/Activities for Release/Emission

- Waste facility cover (367)
- Waste treatment (629)
- Amendments for the treatment of agricultural waste (591)
- Waste transfer (634)
Practices/Activities for Release/Emission (cont.)

- Waste storage facility (313)
- Waste utilization (633)
- Waste storage lagoon (359)
- NEW! – Air Filtration and Scrubbing (371)
Transport/Dispersion

- Independent of system type
- Not many options available for altering transport/dispersion
Practices/Activities for Transport/Dispersion

- Windbreak/shelterbelt establishment (380)
- Windbreak/shelterbelt renovation (650)
- Also:
  - Siting
  - Air movement changes
Summary

• There are positives and negatives to all types of manure management systems
  – There is no right or wrong answer
  – The system chosen should match your purpose and constraints

• Manure management is a process
  – There are many variables to consider
  – There will be trade-offs

• Prioritize your resource concerns
Summary

• Good design and management of manure systems takes into account:
  – Formation/generation
  – Release/emission
  – Transport/dispersion

• The best manure management systems are well-managed ones