



# 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  $\text{CO}_2$  or stays solid
  - Some VOCs and  $\text{CH}_4$  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  $\text{CO}_2$  (aerobic) or  $\text{CH}_4$  (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  $N_2O$
- 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)



# Practices/Activities for Formation/Generation (cont.)

- 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.



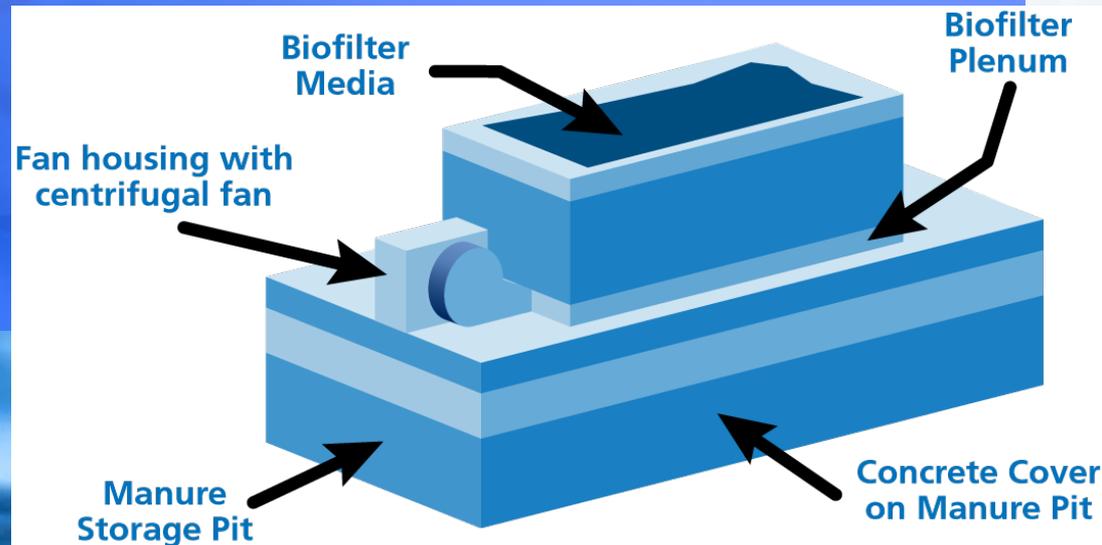
# Practices/Activities for Release/Emission

- 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



# Questions?

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