

# DAIRIES AND AIR QUALITY REGULATIONS

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## Air Pollutants of Concern

- ◆ Ammonia (NH<sub>3</sub>)
  - Superfund and related federal legislation
  - Precursor to secondary fine particles
  - Health implications as co-pollutant w/PM
- ◆ Odor
  - Not the same thing as NH<sub>3</sub>, H<sub>2</sub>S etc.
  - Regulated at municipal/county levels or by nuisance provisions
- ◆ Particulate Matter (dust)

## TCEQ, Dairies and Air Quality 30 TAC §321.43

- ◆ All AFOs must obtain air quality authorization in one of three ways:
  - **Permit by rule** under 30 TAC §106 (F)
  - **Individual permit** under 30 TAC §116
  - **Air standard permit** under 30 TAC §116.615 and 30 TAC §321.43

## TCEQ, Dairies and Air Quality 30 TAC §321.43

- ◆ Air standard permit
  - Applies to permanent odor sources, LMUs, feed milling/ handling and other on-site, associated operations
  - Can be obtained by AFOs with water authorization:
    - ◆ TPDES permit
    - ◆ State general permit
    - ◆ State individual permit
    - ◆ Permit by rule under 30 TAC §321

## State Emission Limitations

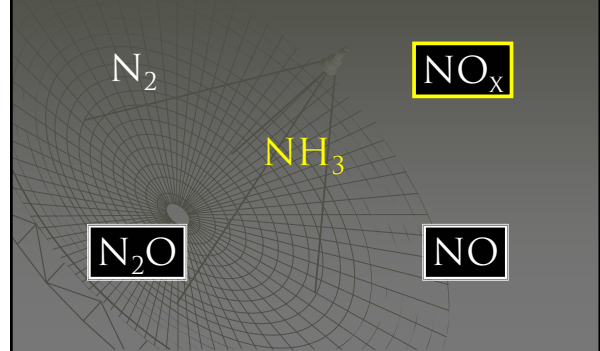
- ◆ AFOs must prevent **nuisance** conditions
- ◆ Must identify and abate any nuisance condition
- ◆ Buffer distance options:
  - ½ - mile buffer
  - ¼ - mile buffer
  - Odor control plan
  - Written consent from neighbors w/in minimum buffer distances

## Odor Control Plan Minimum Provisions

- ◆ Manure collection and storage
- ◆ Land application procedures
- ◆ Dead animal handling
- ◆ Dust control
- ◆ Additional, site-specific provisions as required by TCEQ Executive Director

# AIRBORNE NITROGEN EMISSIONS

## Forms of Atmospheric Nitrogen



## Open-Lot Systems

- ◆ **Beef feedyards**
  - Animal spacing 75-250 ft<sup>2</sup>/hd
  - Excreted N 90% of N consumed in feed (Bierman et al., 1996)
- ◆ **Open-lot dairies**
  - Animal spacing 200-400+ ft<sup>2</sup>/hd
  - Excreted N 70% of N consumed in feed (Van Horn et al., 1996)

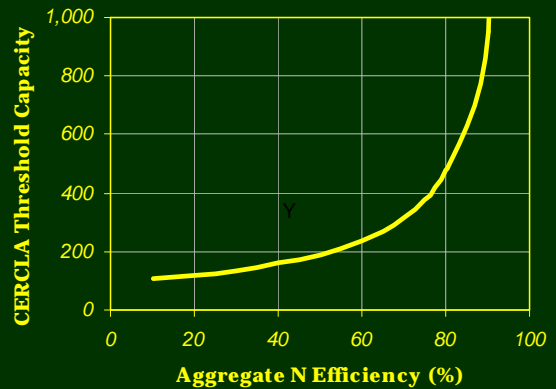
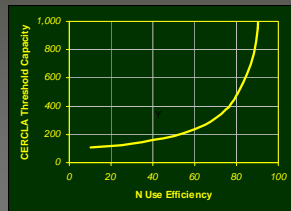


## Fate of Excreted N in Open-Lot Systems

- ◆ Collected in solid manure
  - Spread
  - Stored (stockpiles, mounds, other)
  - Composted and spread
- ◆ Remains on corral surface
  - Stable if it remains dry
  - Runs off into holding pond
- ◆ Volatilized as NH<sub>3</sub>(g) directly
  - Increases with wet/dry cycling

## NH<sub>3</sub> – What’s the Big Deal?

- ◆ Superfund/EPCRA – Federal litigation on broad CAFO front
  - Multiple species
  - Multiple states
  - Do the math
- ◆ NH<sub>3</sub> + (SO<sub>4</sub>, NO<sub>3</sub> or Cl) >> PM<sub>2.5</sub>
- ◆ NH<sub>3</sub> + PM >> synergistic effect on animal pulmonary health >> effect on *human* health?



## Almost, But Not Quite

- ◆ Oct. 25, 2005 – Senate conferees report agricultural appropriations bill with CERCLA/EPCRA exemption for animal feeding operations
- ◆ Exemption rider inserted by Larry Craig (R-ID) and Sam Brownback (R-KS)
- ◆ Oct. 27, 2005 – Final conference report does **NOT** contain Craig/Brownback rider

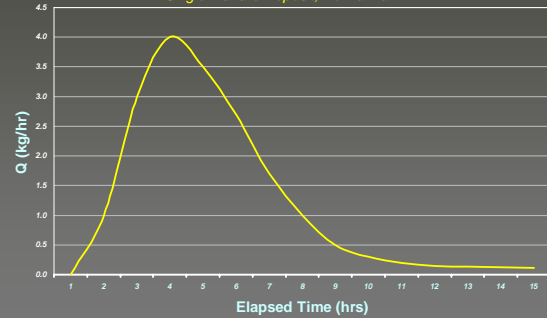
## N Losses – Lagoons

- Significant nitrogen volatilization (40%-60% of excreted) is due to large surface area, long-term storage, and biological activity
- Manure may lose 15%-20% of its nitrogen before reaching the lagoon
- About 10% of the excreted nitrogen may accumulate in the sludge layer and is not available unless agitated
- The nitrogen available in a lagoon system may be only 10%-30% of the nitrogen excreted

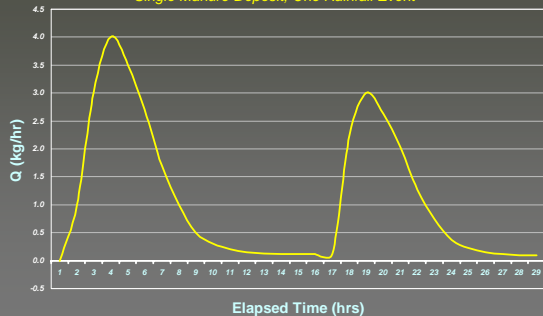
## NH<sub>3</sub> Loss: Open Lots vs. Ponds

- ◆ Open lots
  - Large area source, 2-9 acres per 1,000 head capacity
  - Variable emissions driven by wet/dry cycles, short-term temperature fluctuations
- ◆ Lagoons and holding ponds
  - Smaller area source, 1-10 acres *total*
  - Seasonal temperature fluctuations
  - Continuous releases; f(temp, wind speed, RH)

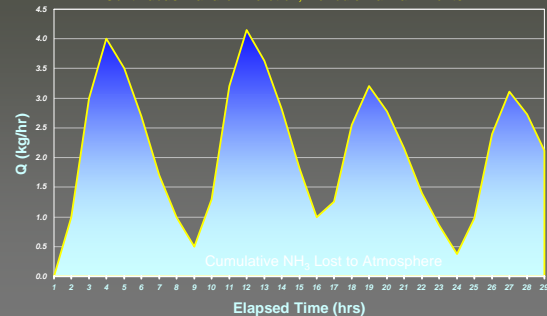
Volatilization Rate vs. Time  
Single Manure Deposit; No Rainfall



Volatilization Rate vs. Time  
Single Manure Deposit; One Rainfall Event



Volatilization Rate vs. Time  
Continuous Manure Excretion; Periodic Rainfall Events



## Source-Resolved NH<sub>3</sub> Emissions

- ◆ CAAQES Faculty Investigators
  - Dr. Saqib Mukhtar, PI
  - Drs. R. Lacey, C. B. Parnell, Jr., B. Shaw
- ◆ Location
  - Hybrid free-stall/open-lot dairy
  - Capacity >1,000 hd
  - Central Texas

## Why Source-Resolved?

“Use of process-based modeling will help provide scientifically sound estimates of air emissions from AFOs for use in regulatory and management programs.”

*Air Emissions from Animal Feeding Operations:  
Current Knowledge, Future Needs  
(National Academy of Sciences, 2002)*

## Why Source-Resolved?

- ◆ Substantial variation among dairy production systems, ancillary operations
  - Free-stall barns vs. open lots
  - Ration, breed, milk yield
  - Lagoons, holding ponds
  - Composting and manure-storage areas
  - Bedding materials
  - Climatic factors
  - Management factors
- ◆ Appropriate regulation of a given source requires emission estimates that reflect *actual production system*, not “typical” or “model” farm



Dairy Layout

## Flux Chamber Sampling Approach

- ◆ Direct, real-time measurement of emission rate
- ◆ Requires multiple sampling points to characterize a spatially variable source
- ◆ Portable, flexible, automated, versatile
- ◆ Not perfect
  - Chambers well known to modify the microclimate
  - Emission flux strongly dependent on sweep-air Q





Data Summary – Emission Rates (kg/day)

Location	Area (m <sup>2</sup> )	NH <sub>3</sub> Jan 03	NH <sub>3</sub> June 03	H <sub>2</sub> S June 03
Compost	16,600	0.3	1.1	0.12
Freestall	9,970	2.8		
Nonfeed	2,700		4.7	0.02
Feed	3,090		8.4	0.12
Compost	3,800		0.3	0.00
Water	200		0.15	1.82
Open Lot	38,000	9.8	6.3	0.00
Crowding Area	925		0.3	0.33
Solids	100	0.03	0.03	0.29
Lagoon 1	19,200	5.2	22.1	10.77
Lagoon 2	17,000	6.7	16.6	0.00

### Distilled Findings

- ◆ Nearly all emission rates are seasonal (main effect: temperature)
- ◆ Drier summertime open-lot surface emits less NH<sub>3</sub> than damp wintertime surface?
- ◆ Measured emission rates are a reasonable fraction of total N intake