

# Mid Atlantic Agricultural Ammonia Forum

Instrumentation and  
Monitoring for Ammonia

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# Instrumentation and Monitoring for Ammonia

## OBJECTIVES

Introduce:

- ◆ The basic equation for calculating emission rates from Agricultural buildings
- ◆ Ammonia monitoring instruments
- ◆ Ventilation flowrate measurement instruments
- ◆ Flux Chambers

# Instrumentation and Monitoring for Ammonia

## BASIC EMISSION RATE EQUATION

Concentration of gas

X

Ventilation flow rate

=

Building emission rate

grams NH<sub>3</sub>/minute

# Instrumentation and Monitoring for Ammonia

## SAMPLE EMISSION RATE CALCULATION

Initial conditions:

29.3 ppm NH<sub>3</sub> concentration

50,000 cfm ventilation rate

$29.3 \text{ ppm} \times 50,000 \text{ cfm} \times \text{conversion} =$   
31.5 g NH<sub>3</sub> / min or .07 pounds / min  
or 100.1 pounds NH<sub>3</sub> per day

# Instrumentation and Monitoring for Ammonia

## Various Ammonia Monitoring Instruments

I classify Detectors in three ways:

Low cost

Medium cost

High cost

# Instrumentation and Monitoring for Ammonia

## Low cost:

- passive diffusion tube
- active diffusion tube

## Medium Cost:

- electronic, data recording
- PAC III and CMS

## High Cost:

- very accurate,
- TEI model 17C and Innova mode 1412

# Instrumentation and Monitoring for Ammonia

## passive diffusion tube

- ◆ direct reading
- ◆ requires no pump
- ◆ broad ranges
- ◆ low accuracy
- ◆ slow response
- ◆ cost = \$5.00/tube

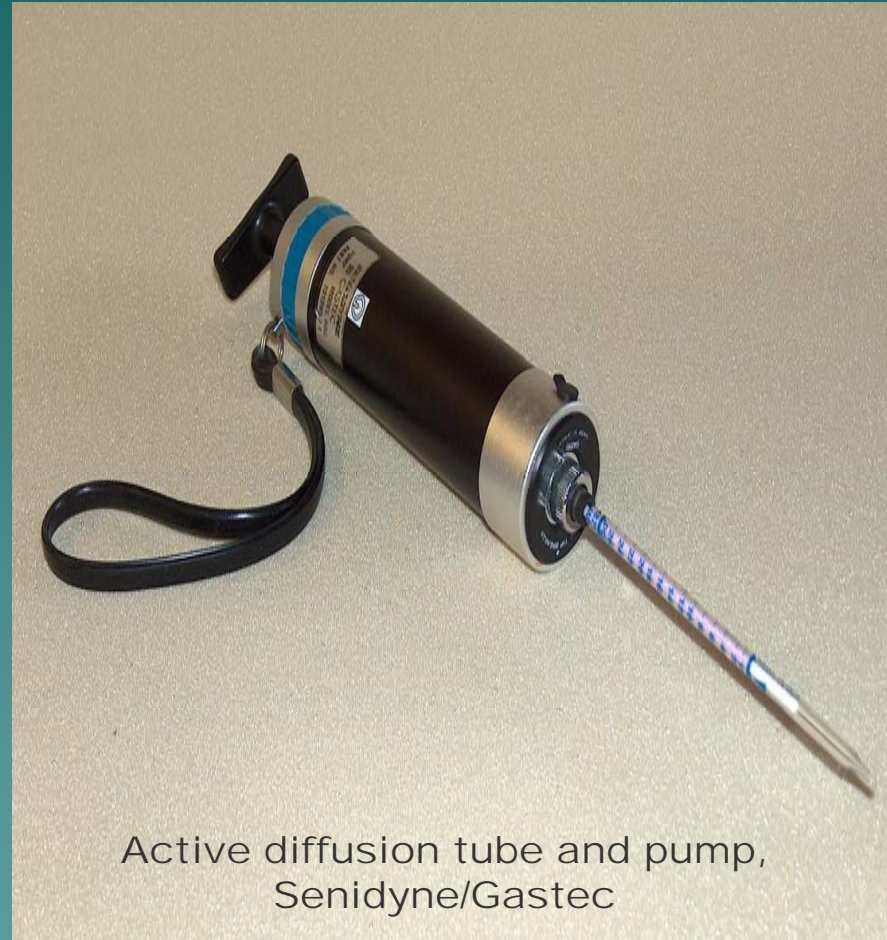


Drager diffusion tube

# Instrumentation and Monitoring for Ammonia

## active diffusion tube

- ◆ direct reading
- ◆ requires pump
- ◆ broad ranges
- ◆ low accuracy
- ◆ quick response
- ◆ cost = \$5.00 tube
- ◆ pump = \$300.00



Active diffusion tube and pump,  
Senidyne/Gastec

# Instrumentation and Monitoring for Ammonia

## Draeger CMS

- ◆ LCD Display
- ◆ uses diffusion tube
- ◆ each chip 10 test
- ◆ internal pump
- ◆ data-recorder
- ◆ +/- 4 - 10% of scale
- ◆ cost = \$1500.00



Draeger CMS

# Instrumentation and Monitoring for Ammonia

## Dräger PAC III

- ◆ battery powered
- ◆ data logging
- ◆ chemical sensor
- ◆ 1 year shelf life
- ◆ +/- 3% of full scale
- ◆ cost = \$950.00



# Instrumentation and Monitoring for Ammonia

## TEI model 17C

- ◆ Chemiluminescence
- ◆ 110 volt AC, 60 Hz
- ◆ menu-driven software
- ◆ fast response time
- ◆ converts  $\text{NH}_3$  to  $\text{NO}$
- ◆ frequent calibration
- ◆  $\pm 1\%$  of full scale
- ◆ cost = \$17,500.00



Thermo Electron Corp. Model 17C

# Instrumentation and Monitoring for Ammonia

## Innova 1412

- ◆ Photoacoustic
- ◆ 110 volt AC, 60 Hz
- ◆ menu-driven software
- ◆ fast response time
- ◆ does not consume sample
- ◆ +/- 1% of calibration value
- ◆ annual calibration
- ◆ Cost = \$42,000.00



# Instrumentation and Monitoring for Ammonia

## Ventilation Flow Measurement

- ◆ Use name plate data on installed fans
- ◆ Carbon Dioxide balance for ventilation flow rate estimate
- ◆ Hand held Vane - Anemometer
- ◆ Fan Assessment Numeration System (FANS)

# Instrumentation and Monitoring for Ammonia Ventilation Flow Measurement

## Extech model 451126

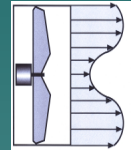
- ◆ Thermo- Anemometer
- ◆ portable
- ◆ data logging
- ◆ computer compatible
- ◆ Use with ABE fact sheet, G - 82, part3
- ◆ Cost = \$300.00



EXTECH Anemometer

# Instrumentation and Monitoring for Ammonia

## Evaluating Mechanical Ventilation Systems Evaluating Livestock Housing Environments Part 3 of 3 G 82



Take air speed measurements at several locations across the fan area.

Cross section of fan showing Large variation in air speed coming off fan tips versus near fan hub.

# Instrumentation and Monitoring for Ammonia Ventilation Flow Measurement

## Fan Assessment Numeration System (FANS)

- ◆ Data logging
- ◆ University Research



# Instrumentation and Monitoring for Ammonia

## Flux Chambers

Units =  $\text{NH}_3$  concentration / area time

Types = Static (closed) and Dynamic (open or sweep air)

- ◆ **Note:** Both types of flux chambers disturb the surface (temperature, wind, pressure effects) so errors in reported calculated emission rates can occur.

# Instrumentation and Monitoring for Ammonia

Static Chamber covers a portion of the floor surface, continuous concentrations recorded, sample analyzer returns air to chamber, flux calculated by change in concentration over time

Dynamic Chamber covers a portion of the floor surface, uses sweep air through chamber, flux calculated by sweep air flowrate times change in concentration

# Instrumentation and Monitoring for Ammonia

## CONCLUSION

To determine the accurate ammonia emission rate from an animal agriculture building, accurate ammonia concentration and accurate building ventilation flow rate are needed.

Flux Chambers can be used where building ventilation rates are unknown. Calculated emission rates may have an error.