Wintertime Factors Affecting Contaminant Distribution in Farrowing Barns

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Background

Exposed to dusts and waste gases generated by swine inside CAFOs, workers have experienced both acute and chronic respiratory diseases:

- Irritation to respiratory tract
- Airflow obstruction
- Bronchial inflammation
- Reduction in pulmonary function
- Chronic bronchitis

Concentrations of dusts and gaseous contaminants differ depending on:

- Size of operation
- Feed and waste handling procedures
- Level of swine activity
- Tasks included in a work shift
- Ventilation practices
- Season

In the Midwest, winter swine confinement operations have little ventilation.

Occupational exposure limits (OSHA, ACGIH) based on time-weighted averages of an 8-hour work shift exist for contaminants found in CAFOs. However, due to the exposure mixture, industry guidelines have been proposed for swine CAFO workers to prevent a decrease in pulmonary function. Personal exposures should be below these limits to prevent illnesses.

Contaminant Exposure Limits

Contaminant	OSHA PEL	ACGIH TLV	Industry Guidelines
Respirable Dust	5 mg/m^3	3 mg/m^3	0.23 mg/m^3*
Carbon Dioxide (CO_2)	5000 ppm	5000 ppm	1540 ppm*
Ammonia (NH_3)	50 ppm	25 ppm	7 ppm*
Hydrogen Sulfide (H_2S)	10 ppm	1 ppm	---
Carbon Monoxide (CO)	50 ppm	25 ppm	---

OSHA – regulatory permissible exposure limit (PEL)
ACGIH – international consensus threshold limit value (TLV)
***Donham, et al. 1989**

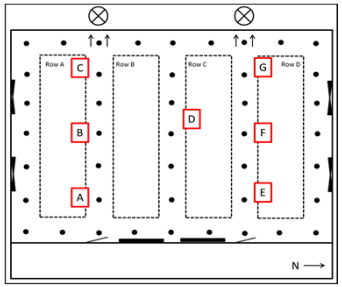
Study Questions

1. **Does the pit fan reduce concentrations?**
2. **Does concentration change throughout the day?**
3. **What is the most efficient method to characterize concentrations?**

Methods

Measured 5 random days over 3-weeks, in winter, 19-crate farrowing room

- **Fixed areas:**
  - **7 stations (A-G)**
  - **Continuously throughout day**
- **Mobile monitoring for mapping:**
  - **43 positions**
  - **Three 90-minute events per day**



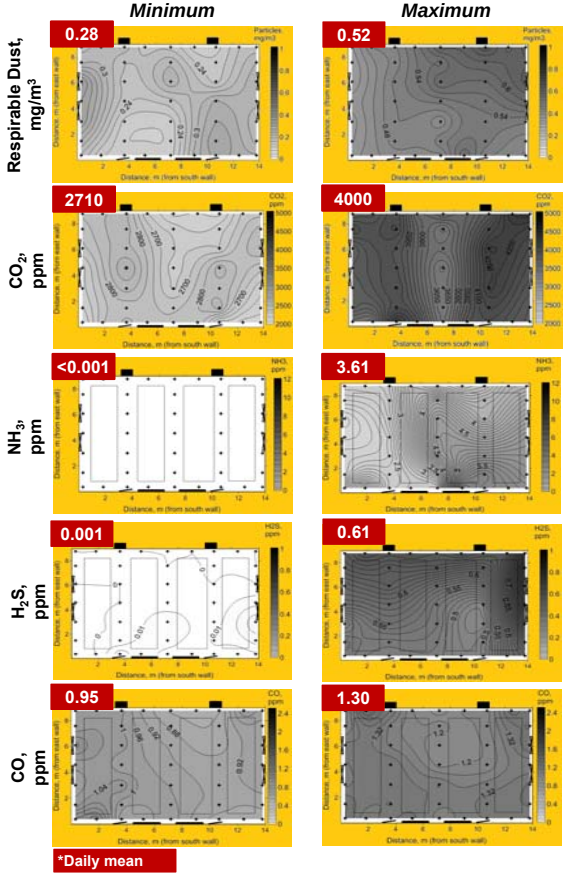
Schematic Diagram of Sampling Locations

Samples were collected from 7:00 AM – 12:00 PM

- **Afternoon concentrations were not measured**

Results

Daily Concentration Range over Study Period



Results, *continued*

Pit fan reduced mean concentration of:

- **Respirable dust, mg/m^3: Off = 0.47 On = 0.33**
- **CO_2, ppm: Off = 3660 On = 2920**
- **NH_3, ppm: Off = 8.36 On = 3.92**
- **H_2S, ppm: Off = 0.48 On = 0.11**

Respirable dust levels were highest before 10:00 AM

- **Potentially related to feeding time**

Every day, CO_2 levels increased over time. Larger increases were seen with the pit fan off.

Recommend not to use a single 'central barn' sampler as an indication of average room exposure in a farrowing CAFO.

NOTE: *This project did not assess personal exposures.*

Workers spent a limited amount of time inside the barn during these 5-hour testing periods ⟶ *lower exposure risk.*

In production operations, workers may spend a full shift inside farrowing barns performing more tasks ⟶ *higher exposure risk.*

Personal monitoring is needed to assess *personal exposure* risk. Personal exposure data require workers to wear a sampling pump or monitor for a full-shift to include task-specific exposures and time spent outside of CAFO units over a "full shift" (e.g., 8-hours).

Conclusions

Contaminant area concentrations did *not* exceed regulatory occupational exposure limits.

Respirable dust, CO_2, and NH_3 fixed-area station mean concentrations exceeded *industry guidelines*.

Pit ventilation *reduced contaminant concentration* in a farrowing barn during winter, *but not below industry guidelines* for respirable dust, CO_2, and NH_3.

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