Evaluation of Shaker Dust Collector for Use in a Swine Farrowing Barn

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Background

U.S. swine producers use concentrated animal feeding operations with herd sizes of 1,000 to 10,000 swine.

- U.S. swine inventory: 63 million (March, 2014)
- High density of livestock
- Large enclosed buildings
- Upper Midwest: seasonal cold climate
- Wintertime ventilation rates: low
- Dust concentrations: elevated in winter
- Agricultural dust inhalation causes respiratory symptoms and allergic reactions

Control methods are needed to reduce dust concentrations below recommended threshold levels.

- Dilution ventilation: cost prohibitive in winter
- Feed modification: ineffective for non-feed dusts
- Vegetable oil spray: effective but can create a housekeeping burden
- Air cleaner: lab test of shaker dust collector

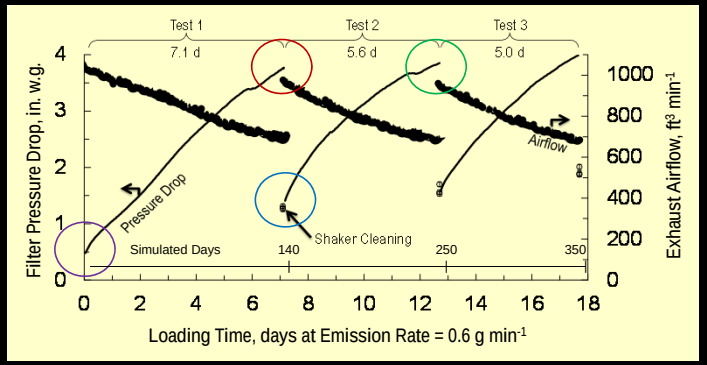
Objectives

Will the dust collector last all winter in a swine barn?

• Collection efficiency	What is the performance for 90 days, continuously at 1 mg/m^3
• Efficiency changes with cleaning	New filter, loaded filter, after shaking (filter-cleaning)
• Startup requirements	How long until filter achieves high collection efficiency

Results

Airflow and pressure drop over time



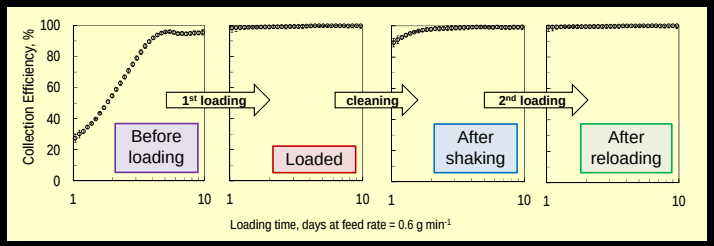
New

Loaded

Airflow reduced from 1000 cfm to 700 cfm with 4" wg pressure from dust build-up on filter

Repeated shaking did not recover significant pressure drop when cleaning

Collection efficiency



Filter collection efficiency changed over time

New:
~27% for 1 µm to 96% for 10 µm particles

Loaded with dust:
> 99% for 1 to 10 µm particles

After cleaning:
~ 91% for 1 µm to ~99% for 10 µm particles

Subsequent loading, post cleaning:
> 99% for 1 to 10 µm particles

Methods

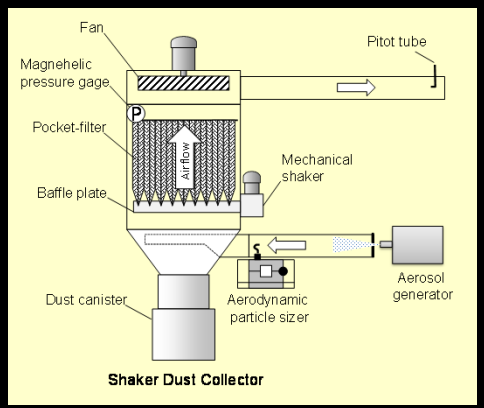
Equipment criteria
Off-the shelf unit, sized for Ag farrowing barn
Easy for Agricultural workers to operate and clean

Equipment selected
Filtration device (Shaker dust collector, Model 140, United Air Specialists Inc., Cincinnati, OH)
Filter material: polyester sateen weave

Laboratory tests to simulate swine barn loading
Simulated barn loading with coarse Arizona test dust
Feed rate: 0.6 g/min
Simulated time:1 day lab = 20 days in a swine barn
Three sequential tests were performed

Measured collection efficiency with APS using glass beads **(1-10 µm)** as challenge aerosol

Cleaning
3 cleaning cycles were run after each of the 3 loading tests
Pressure drop changes recorded for each



Conclusions

Shaker dust collector has adequate capacity to treat swine barn air continuously over a 3-month period at a dust concentration of 1 mg/m^3

- High collection efficiency (>99%) of particles (d_p 1-10 µm) was achieved after 2 days (40 barn-equivalent days)
- High collection efficiency (90-99%) was achieved after shaking

One shaking cycle was sufficient to remove dust from the filter and recover pressure drop

Shaker dust collector with recirculation may be a feasible system to incorporate into agriculture to improve air quality in CAFO

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