RESEARCH IN PROGRESS

Improving Indoor Air Quality Improvements in Swine CAFO: A Field Evaluation of Mechanical Ventilation With Air Filtration

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Purpose/Objective:
The objective of this project is to improve air quality in swine CAFO by treating and recirculating air in a farrowing barn. The study focuses on winter conditions, when contaminant concentrations are the highest due to minimal ventilation in production operations as producers minimize heating costs. Building on preliminary studies using numerical simulations of cost and air quality, this study reports indoor air quality findings associated with field testing of a recirculating ventilation system combined with particle filtration, deployed from December 2013 through March 2014.

Methods/Efforts:
A ventilation system was designed for and installed at a four row (19 crate) farrowing room at our intervention site (Mansfield Swine Education Center, Kirkwood Community College, Cedar Rapids, IA). Ductwork was installed to capture air inside the barn and transport it to an outside shaker dust collector system (United Air Specialists, Ohio), where particles were filtered. The treated air was returned to the barn and distributed through overhead ducts along the same main aisles. The indoor air quality was assessed using 24-hour sampling, both with (N=11 days) and without (N=7 days) the air handler on. Direct reading instruments were used to measure respirable dust, ammonia, hydrogen sulfide, carbon dioxide, carbon monoxide, and temperature/relative humidity. Integrated samplers were also used to generate inhalable and respirable dust concentrations.

Results/Findings:
Ammonia and hydrogen sulfide concentrations were below recommended occupational exposure levels during this study, consistent with previous baseline monitoring activities. Dust concentrations in the room were reduced by 32% (inhalable) to 40% (respirable) when operating the system. At 100% recirculation, the ventilation system did not introduce cold air into the barn. Carbon dioxide, generated by the non-ventilated gas-fired heater, was problematic and recommendations to replace the heater to a ventilated model have been made. The presentation will compare air quality with and without the ventilation system and highlight practical considerations to adopting recirculating ventilation solutions in Midwestern Swine CAFO operations.

Application to Field Research:
While the current intervention was designed to apply to the dimensions of one particular swine farrowing facility, the methodology used can be applied to other barn designs. The results from this field demonstration trend well with numerical simulations, providing validation data for future computer simulation studies. The findings of this work can be useful to providing evidence to producers and CAFO builders that improved ventilation is an effective way to reduce hazardous concentrations in swine operations.

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