RESEARCH ABSTRACT

ENVIRONMENT

Title: Determining PM and Odor Emission Reductions of a Geothermal Heating/Cooling System in a Grow-Finish Building - **NPB #12-128**

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Scientific Abstract:

A study was conducted at a commercial, full-scale swine grow-finish facility located in western Minnesota. The facility consists of 16 rooms that hold 400+ pigs each plus some smaller rooms for utilities, office space, and a half room for temporary and/or overflow pig housing. The pig flow for the facility consist of groups (400+ head) of pigs of the same sex that weigh 55 to 60 lbs/pig entering a room every week, which alternates between barrows and gilts. The dimension of each 400+ head room is 60 ft. x 60 ft. for a nominal pig density of nine ft^2/pig. The barn's layout consisted of two rows of rooms with a center access hallway for loading/ unloading pigs plus exterior hallways that served as air tempering plenums. The ventilation system provided a maximum or summer ventilation rate of approximately 100 cubic feet per minute (cfm)/pig in the conventional rooms and 1/2 of this total or ≈ 50 cfm/pig for the geothermal rooms. Four of the 16 rooms in the building have a ground (deep wells) source or geothermal system that tempers the incoming ventilation inlet air, while the remaining 12 rooms had no tempering of the inlet air. The geothermal system consisted of 3 geothermal heat exchangers, with 32 thermal deep well loops for each exchanger. In total, the geothermal system includes 96 wells that are roughly 250 ft. deep. All 16 rooms in this barn had a "sort" feeding system vs. the more common barn layout with long/narrow pens and fence line feeders. Manure was collected by a fully slatted floor over a deep pit (8 ft. deep) under each room. Each room's deep pit had one pull plug in the bottom of the pit floor that transferred manure to a central sump, which was then pumped to a large outside buried concrete pit with a concrete cover. Results found that both odor and PM emissions were lower in the rooms that had the geothermal heating and cooling system compared to the conventional ventilated rooms. This result is probably due to the lower ventilation rates that were present in the geothermal rooms, since the air samples collected in both rooms had quite similar values of odor and PM concentrations. The odor emissions measured in this study is similar in magnitude to other reported values of 10 to 12 OU/s/m^2 (Jacobson, et al., 2007) and 5.0 OU/s/m^2 (Heber, et al., 1998). The same was the case for PM emissions measured in this study when compared to another study (PM_{10} emissions of 0.15 to 0.75 g/d/pig, Jacobson, et al., 2007) after adjusted to TSP values. No improvement in pig performance was found in pigs in the geothermal rooms vs. those in the conventional rooms. A possible reason why this was not found was that 2014 was an unusually cool year in western Minnesota. Also, the fossil fuel use on electrical energy use, in the conventional rooms was an estimated $3.10 per pig place while the geothermal rooms spend $3.70 or about 20% more. Thus, based on the results that pig performance was not improved and that energy use in the rooms with the geothermal heating/cooling was actually slightly more than the conventional rooms, the return on investment in the geothermal system is marginal at best. The only positive return seems to be a slight reduction in the emissions of odor and particulate matter.