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Tyson Foods Air Pollutant Emission Monitoring

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Summary and Implications

Iowa State University (ISU) is measuring air emissions from two Tyson broiler chicken houses in western Kentucky as part of a new air compliance agreement between the Environmental Protection Agency (EPA) and industry groups. The \$1 million project in Kentucky, funded by Tyson Foods, was originally designed to monitor just ammonia. But the EPA agreed Iowa State could expand the project to include other items of interest - carbon dioxide, three types of particulate matter, hydrogen sulfide and non-methane hydrocarbons.

Introduction

The objective is to provide valid baseline data on aerial emissions from typical U.S. broiler houses to regulators, producers, researchers, and other stakeholders after continuously sampling the two broiler houses for 12 months. Aerial pollutants of particular interest in livestock buildings are ammonia (NH_3), hydrogen sulfide (H_2S), non-methane hydrocarbons, and particulate matter (PM_{10} , $\text{PM}_{2.5}$ and TSP). Odor emitted from livestock buildings contribute to nuisance experienced in areas surrounding livestock production. Carbon dioxide (CO_2) emissions are thought to be an important greenhouse gas but vegetation provides a substantial sink and the primary reason for measurement of CO_2 is for the assessment of building ventilation.

Measurements to be taken:

- Inside and outside temperature and relative humidity.
- Fan status (on/off) and airflow rate.
- Operation of lights, feeders.
- Static pressure difference between inside and outside the barn.
- Inside and outside ammonia and carbon dioxide concentrations.

Materials and Methods

The houses are tunnel ventilated with air inlets along the sidewalls, which is representative of the typical production practices in terms of housing style (e.g. tunnel

ventilated) and environmental control strategy (e.g., pancake brooder along with space heaters), bird management (e.g., half-house brooding), and typical litter management and handling schemes (e.g., de-caking along feed and water lines after each flock and top dressing with fresh bedding).



Figure 1. Mobile Air Emissions Monitoring Units.

Emissions from each broiler house will be monitored using Mobile Air Emissions Monitoring Units designed and built at ISU. Air samples from the house sampling points (representing the exhaust air streams) to the instrument trailer/analyzers are protected against in-line moisture condensation with insulation and temperature-controlled resistive heating cable. Building airflow is also being monitored continuously. All the instantaneous, real-time readings of the measured variables are remotely viewable through a high-speed modem. Each trailer houses the gas sampling system, gas analyzers, environmental instrumentation, a computer, data acquisition system, and other equipment needed for the study.



Figure 2. Instrumentation inside of a Mobile Air Emissions Monitoring Unit.

The basis for the experimental design of this project is continuous measurement of ammonia concentrations and building ventilation rates to determine the ammonia emission rate from broiler houses. Ammonia (NH_3) emission rate (ER) from a broiler house to the atmosphere is simply the product of the difference in NH_3 level between

the exhaust and the incoming ventilation air and the amount of air exchange through the house, with proper unit conversion and correction for temperature and barometric pressure effects.



Figure 3. Inside view of one of the broiler houses.

An array of 2-way solenoid valves (#1-#8) in a gas sampling system (GSS) located in the instrument shelter allows semi-continuous measurements of gas concentrations by automatic sequential gas sampling through 3 to 120-m long, heated Teflon tubes (6.4 mm ID) at 16 L/min from multiple locations. Individual air samples for both in-house and background locations, will be analyzed for both NH₃ and CO₂ using an INNOVA 1412 Photoacoustic Multi-gas

monitor with both RS232 and analog output. Because the INNOVA 1412 has a separate filter for each analyzed component, it can continuously monitor both NH₃ and CO₂.

Air samples will be drawn from three locations in each house.

1. One is located near the primary minimum ventilation (36-in) sidewall fan (SW1) used for cold weather ventilation (in the brooding half of the house).

2. The second sampling location will be near the third sidewall (36-in) exhaust fan (SW3) (non-brooding end).

3. The third location will be near the 123 cm (48 in) fan for the first and higher stage (TF1) of tunnel ventilation mode.

Air will be collected via 3/8-inch o.d. and 1/4-inch i.d. tubing. Teflon tubing that will be positioned in front of the exhaust fans (1/3 fan diameter down from top, 6-inch horizontal offset from fan center, 18-inch in front of fan intake).

Results and Discussion

This project is currently in progress. Each building will be sampled continuously for 12 months, starting in fall 2005. The 12-month duration assures this project will meet the objectives of characterizing long-term emissions and to respond accurately to the need for annual emission factors from animal facilities by regulatory agencies and others. Long-term measurements allow the recording of variations in emissions due to seasonal effects, animal growth cycles, and diurnal variations.