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WINTER TEMPERATURE, RELATIVE HUMIDITY AND AMMONIA CONTROL IN BROILER HOUSES: A PENNSYLVANIA CASE STUDY

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Winter Ventilation

Cold winter weather provides challenges for maintaining a comfortable indoor environment, whether it is in our own homes or the poultry house.

A healthy environmental condition with economical production of broilers is a primary ventilation goal, yet minimization of fuel use often drives management decisions.

Birds will substitute costly feed for fuel if conditions are too cool. Pennsylvania has relatively cold winters compared to other major poultry-producing regions that makes management of fuel use and ventilation strategies more challenging.

For this reason, the Pennsylvania Broiler Research Program funded a study where the primary objective was to document winter ventilation strategies and environmental conditions and relate these to bird productivity. Three Pennsylvania broiler houses were each monitored over three complete 35-day production cycles with the goal of stimulating more informed management decisions in relation to control of broiler house environment.

The Study

Broiler houses from one integrator company were studied to minimize variability among houses. Three houses were selected which were as similar to each other in size, age, type of construction, equipment (water and heating equipment, in particular), and litter conditions.

The houses contained space unit heaters mounted about 40 inches off the floor. Studying the same houses for all three cycles was done in an attempt to provide repetition of conditions and results. Growers and management were interviewed to determine ventilation goals, fuel use practices, and general growout policies. The winter of 1997/1998 was unusually warm compared to average and affected results.

Data collections were primarily electronic using small, portable sensors with data loggers. One set of outdoor temperature and relative humidity sensors provided a sense of the challenge faced by the environmental control system. Inside, three sets of temperature and relative humidity sensors were used to determine any variation in interior conditions due to uneven heat and fresh air distribution. An ammonia sensor was centrally located in the house. It was hung about one-foot off the floor in a wire cage suspended from the ceiling to discourage roosting, yet the birds could get under the sensor for normal manure deposition around the sensor site. Weekly data downloading and collection trips included hand-held instrument readings to supplement and verify the electronic data.

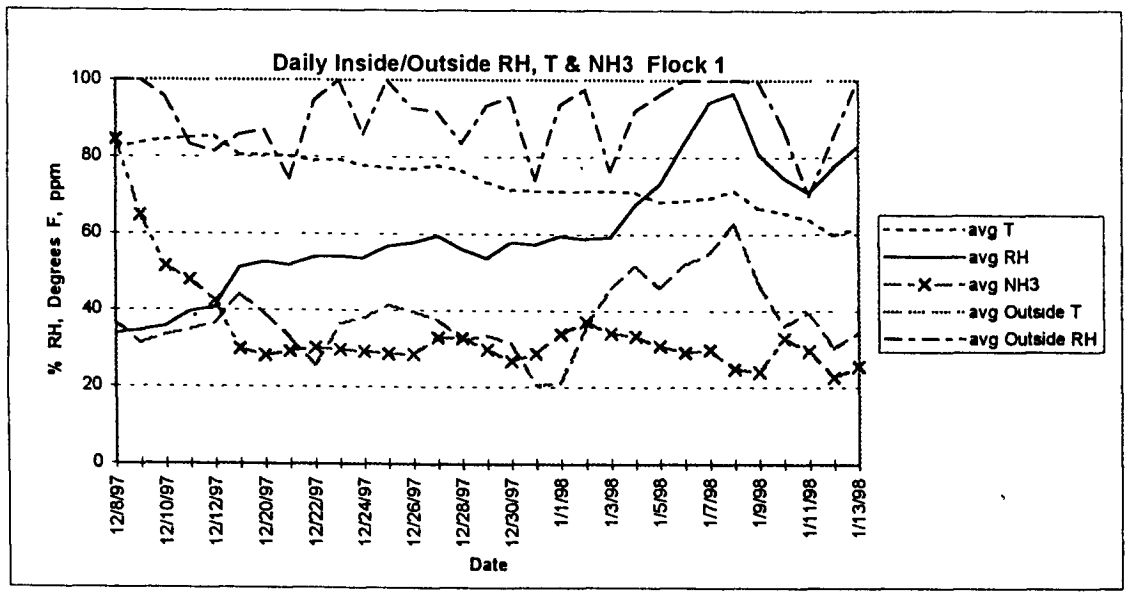

Figure 1. Flock 1 on once-used litter. Outside T and RH along with indoor bird-level ammonia, T and RH. Each daily data point is an average of 1-minute interval data over a 224-hour period.

Indoor Environment Conditions

Environmental data from three different flocks from one farm are presented in Figures 1, 2, and 3 with one graph for each flock cycle. These temperature (T), relative humidity (RH), and ammonia (NH3) data were measured at about 1 foot off the litter.

Temperature of 90 degrees F is desirable at litter-level for chicks during the first three days after placement. Temperature is then dropped about one degree every day until 70 degrees F at market age is reached. During these three flock cycles, temperatures at chick-level were about 82 degrees F on day 1 but the temperature increased a few degrees over the following three days. The thermostat was located at about 5 feet off the floor. Its setpoint temperature was obviously not matching temperature conditions at the lower bird level. More information about temperature stratification findings will follow in a subsequent article.

Relative humidity indoors was within the acceptable 40 to 60% range during the early parts of all three cycles. Later in the cycles, when ventilation rates were increased to accommodate the larger bird weights, the RH was more likely to follow outdoor RH trends, which is acceptable. Especially during the first three weeks, when timer fans and minimum ventilation for ammonia and humidity control were employed, the RH was within acceptable limits for all three flocks (except during some very humid days during the second week of Flock 3).

Ammonia level was generally within the desirable 0 to 25 ppm range during the first two weeks of Flock 2 on new litter, but was well above acceptable levels during week-one for the other flock cycles on reused litter. Day 1 average ammonia level was 84 ppm for Flock 1 and 122 ppm for Flock 3. These high levels decreased dramatically during the following week. Flock 1 ammonia level settled into a fairly steady 28 to 38 ppm level over the balance of the flock cycle while the Flock 3 level fluctuated from 26 to 56 ppm. The major difference contributing to the low Flock 2 ammonia level was the use of new litter. The first and third flocks were both on once-used litter that volatilized large quantities of ammonia.

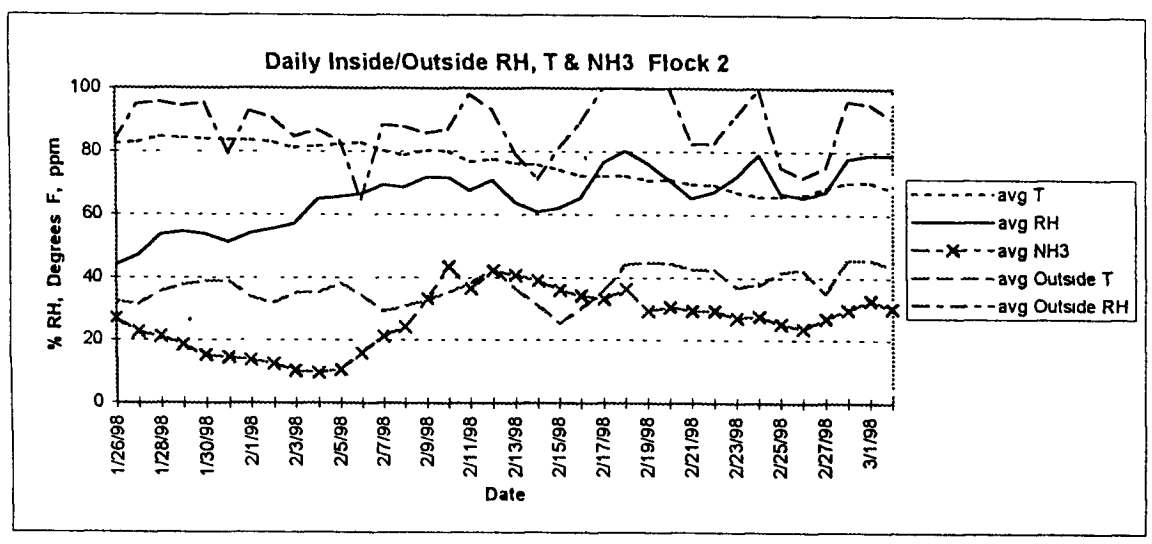

Figure 2. Flock 2 on new litter. Outside T and RH along with indoor bird-level ammonia, T and RH. Each daily data point is an average of 3-minute interval data over a 24-hour period.

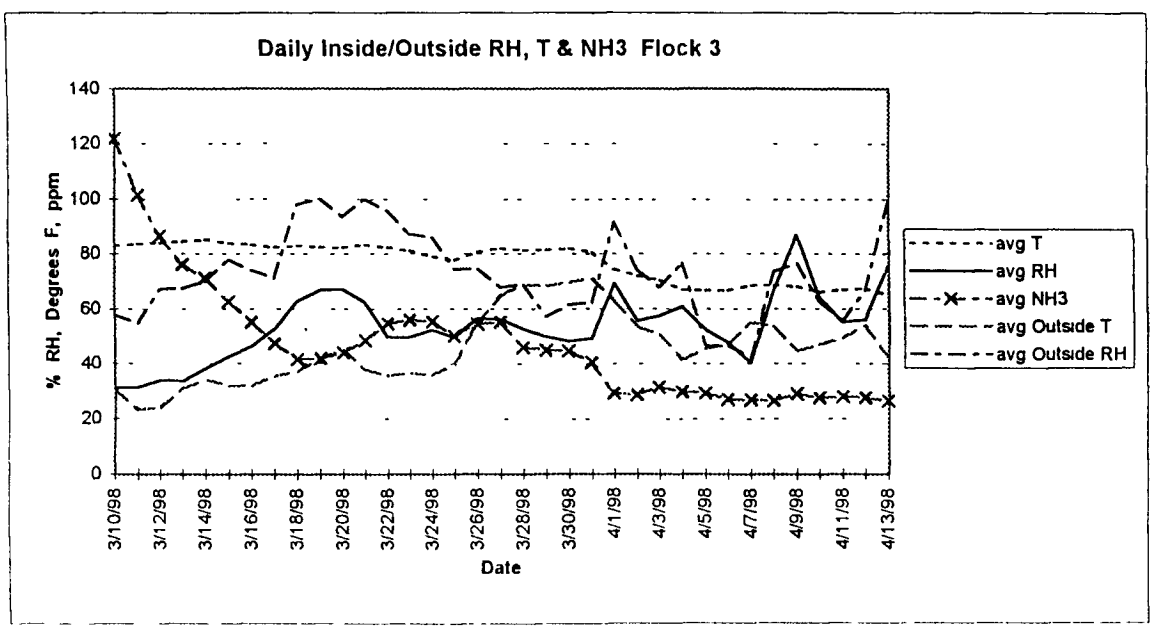

Figure 3. Flock 3 on once-used litter. Outside T and RH along with indoor bird-level ammonia, T and RH. Each daily data point is an average of 3-minute interval data over a 24-hour period.

Flock Performance

The productivity results among the three flocks were diverse. Flock 1 performed the worst of the nine flocks under study in bird productivity, mortality, and financial return to the grower.

The second flock was second best of the nine flocks in return in cents/lb bird grown and the best in terms of a growth index our research group derived to measure flock productivity. The third flock was in the mid- to low-range of these measurements.

More About Ammonia And Humidity

One old "rule of thumb" that by controlling humidity, the ammonia level would likewise be at an acceptable level was not confirmed by these data. Especially during week one when chicks would be most susceptible to ammonia challenge, the ammonia fluctuations and humidity pattern were not related. Acceptable humidity during week one was only matched with acceptable ammonia in Flock 2 on new litter. With old litter, it would appear that relative humidity and ammonia level are not positively correlated. This has been found in other studies.

There has been discussion among our research group that exposure to elevated levels of ammonia during the first few days after chick placement has a greater impact than after the brood period. Other recent research has demonstrated the more detrimental effect of high (100 ppm) ammonia level exposure for 19 days versus continuous exposure to moderate (50 ppm) ammonia over 33 days. That experiment was on older birds from 28 to 65 days of age. Our experiment suggests that even short term exposure to high ammonia levels during the first one, two, or three days of life can inhibit bird productivity. Further analysis is underway to better quantify this effect into an industry-usable guideline.

Conclusions

Ammonia levels were much higher than expected in the houses during early stages of the growout. We were all a bit surprised at this. The integrator personnel were disappointed, as one might expect, especially since these managers have a very good understanding of ventilation concepts. The growers were not aware of the magnitude of the ammonia level. One might think that these results were unusual or that we chose the worst case to present here. In fact, this was an above-average grower who has a "typical" understanding of ventilation and environmental control. Similar results were found at the other two study farms.

Upcoming articles will address more aspects of the cool temperatures found at chick level and more specifics of the ammonia control issue.

Application Of Results

Place more emphasis on having a service person present when chicks are placed in a house to assure that environmental conditions, such as ammonia level and floor temperature, and other established husbandry practices are in place for the chicks. We suggest a service person do this, as the integrator company is more likely to own the instrumentation necessary to perform these functions.

Purchase instrumentation capable of detecting ammonia. Sampler pumps with ammonia tubes are common. Passive sampler tubes are also an effective tool. The growers, in particular, recognized their diminished ability to detect ammonia stemming from repeated exposure during chores. A sampler tube will offer a way of providing quantification of ammonia conditions that are difficult to detect. Instrumentation information is available from the authors.

Consider litter additives, fresh litter during winter flocks, or increased winter ventilation for ammonia control. A follow-up study will be evaluating the effectiveness and costs of these alternatives.