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CHICK-LEVEL TEMPERATURE A CONTINUING CHALLENGE IN BROILER HOUSES

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What is the temperature at bird-level in a broiler house? Is it the same as the temperature at the heater thermostat hanging five feet off the floor? I think we are all inclined to say "no." It would be cooler nearer the floor at bird level.

Most fan and heater thermostats in broiler houses are at about eye-level for ease of operator adjustment. Many growers follow the good practice of hanging a thermometer alongside the thermostat to further check temperature. But the temperature at human level is warmer than floor level in a house using furnaces. Brooders partially compensate for this problem by directing their heat right at the target: the chicks on the floor. But is the temperature right for the birds under a brooder? How close is the floor temperature to chick target temperature for a house using either unit furnaces or brooders, or both?

The goal has been to provide from 85-90 degrees F floor temperature for chicks on the day of placement and then to drop that temperature about one degree each day until the birds are at about 70 degrees F for the final week. In order to have an 85 degrees F floor temperature, a furnace-heated house would need an air temperature around 90 degrees F. Growers realize the importance of providing proper temperature for day-old chicks and preheat a furnace-house for around 48 hours in an attempt to get the house back up to the 90 degrees F temperature after the cleanout period. Many growers are unaware of how cool the floor temperatures are in their houses.

The past winter (1997-1998), the Pennsylvania Broiler Research Program funded a study of environmental conditions within Pennsylvania broiler houses. One major objective of the study was in ammonia monitoring, which was reported in a previous article, but some interesting findings related to temperature conditions in the houses are reported in this article. Three broiler houses at one integrator company were selected. These houses were as similar to each other in size, age, type of construction, equipment (waterers and brooders, in particular), and litter conditions as possible. All houses had forced-air unit heaters. Additional criteria to minimize variability among the farms and trails were same bird breed and similar bird age (within one week).

Environmental data collections were primarily electronic using small, portable sensors with data-loggers. One set of outdoor temperature (T) and relative humidity ((RH) sensors at each farm provided a sense of the challenge faced by each house's environmental control system. Inside, three sets of T and RH sensors were used to determine any variation in interior conditions due to stratification or uneven heat and fresh air distribution. Two sets were centrally located one above the other. One of these sets was located near bird level about 12 inches off the floor, in a protective cage, and the second set hung on a thermostat about five feet off the floor. The third sensor set was located at bird level nearer a sidewall exhaust fan. Heaters were positioned along the sidewall opposite this exhaust fan sidewall.

Temperature stratification is a well-known consequence of furnace use, particularly at minimum ventilation rates. Furnaces direct the heated air well into the room but when the ventilation system inlets do not provide adequate mixing of this heated air with cooler outside air, there is little reason for the hot air to drop to floor level. Warmer air accumulates nearer the ceiling where it is only disturbed when the timer fan comes on, the inlets open, and some fresh air exchange and mixing occurs. Undersirable temperature stratification is a consequence of the combination of inadequate timer fan/inlet and furnace use.

Compounding the stratification problem is that thermostat height for heater control is often positioned at human shoulder level. Temperature at this height may indeed be appropriate for chick comfort and health but unfortunately, the chicks are down on the floor. Temperature at the lower chick level is usually cooler due to temperature stratification.

A look at an example using data from last winter's study demonstrates the problem. The figure shows temperature stratification with a reasonable temperature of around 88 degrees F being maintained at thermostat height of 5 feet from the floor while the chicks are exposed to 81 to 84 degrees F temperatures near the floor. The floor level temperature was a bit warmer in the building center than nearer the sidewall exhaust fan location. Infiltration from the fan louvers or being farthest away from the heater units likely contributed to the cooler sidewall temperatures.

The cool floor level temperatures were not unique to this flock. Day 1 floor level temperature in the nine flock cycles under study averaged 84 degrees F. Four flocks had an 81-82 degrees F starting temperature while one flock had the desired 90 degrees F floor level temperature.

What To Do About Temperature Stratification

• Position thermostaats or sensors nearer bird level than at human height. It will cost more in time than cable to drop the sensors down near bird level, but some growers are already doing this. Certainly, new construction and ventilation equipment upgrades should include bird level sensors whether they are connected to thermostats or electronic controllers. With lower sensors, a grower would have known that the birds in our example were at 83 degrees F, not 90 degrees F, and could have taken corrective action.

• Make sure minimum ventilation is used effectively. This is oftn accomplished with one or two timer-fans in the broiler house brooding section.

Minimum ventilation provides air exchange by removing stale, moisture-laden air and replacing it with fresh air. Minimum ventilation also, just as importantly, provides mixing of this fresh air with room air. A properly operating inlet will destratify the room air. Inlets operate effectively with at least a 0.05inch static pressure difference which will ensure that air enters the house with enough velocity (700-1,000 feet per minute) to provide good air mixing.

• Five-minute timers are recommended. Ten minutes timers have been more commonly used on minimum ventilation timer fans yet especially in the brood chamber, an upgrade to five minute timers will improve temperature control. Rather than using a ten-minute timer set at, for example, 2 minutes out of ten, the five minute timer would be set at 1 minute out of five. This results in the same amount of fan "on" time and the same fresh air exchange but the house environment benefits from more frequent air mixing and hence, less chance for temperature stratification to develop. There is less "dead air" time between fresh air mixing cycles. A more uniform temperature will be maintained in the house by adopting five-miniute timers.

• Mixing fans can be an effective, if expensive, solution. These fans (typically 24- to 36-inch diameter) are hung from the ceiling to mix air horizontally within the house. They are spaced every 50 feet to 100 feet down the middle of the house and positioned to avoid "wind chill" on the chicks. The expense of mixing fans is in initial fan purchase, wiring for installation and electricity use. Ideally, well-designed and properly managed inlets on the ventilation system should accomplish the same function.

My suggestion would be to implement the top three solutions before adopting mixing fans. To a ventilation engineer, mixing fans as a winter ventilation solution are a "cosmetic" fix to a more fundamental ventilation problem. Indeed, they often solve the problem and may be the best option for older, loosely constructed houses where static pressure difference is difficult to maintain and/or the inlets cannot throw air into the middle of the house. Adoption of bird level temperature sensors, five-minute timers and more effective inlet functioning will be better long-term solutions than mixing fans.

Finally even with improved features and management in place, what can a grower or a service person do to monitor temperature at bird level? Consider purchasing temperature measuring instruments. Certainly, even a cheap thermometer ($5-$15) hung at bird level is a good indicator of air temperature. Hand-held T and RH instruments ($50-$100) will allow readings to be taken at any place in the house. Infrared temperature sensors (approximately $200) are gaining use in broiler houses. These hand-held instruemnts sense the temperature of a surface, such as the floor, rather than the air temperature. These tools together can be diagnostice in determining whether appropriate temperature at floor levels is being provided for the birds. There are also electronic sensors with built-in dataloggers ($180 per unit plus supporting software) that can monitor temperature and relative humidity every few minutes. More information on use of these units will be in an upcoming article.

Temperature stratification will naturally occur in broiler houses. Our goal is to minimize its development. Monitoring environmental conditions at bird level is the first step in effectively eliminating cool floor temperatures during brooding.