Poultry Engineering, Economics & Management

Newsletter of the

National Poultry Technology Center, Auburn University

Critical Information for Improved Bird Performance Through Better House and Ventilation System Design, Operation and Management

Produced in cooperation with the U.S. Poultry & Egg and Alabama Poultry & Egg Associations

Issue No 72, July 2011

6 Top Tips for Best Tunnel Cooling

By Jess Campbell, Dennis Brothers, Jim Donald and Gene Simpson
National Poultry Technology Center, Auburn University

Hot and humid conditions in most of the Broiler Belt for the last 30 days have resulted in many phone calls about how to manage tunnel ventilation to get maximum cooling for birds under these extreme conditions. This newsletter outlines the six key points, based on both research and field experience, that are the most important things a grower can do to help birds stay cool in extremely hot and humid conditions. Most of these are very basic; and we have to say also very often neglected. We'll list the points first just briefly, then get into some details.

Tip 1. Keep fan shutters, blades and fan guards clean.

Tip 2. Replace fan belts and pulleys before wear has an effect on rpm's.

Tip 3. Make sure there are no restrictions on tunnel airflow.

Tip 4. Eliminate all air leaks.

Tip 5. Keep cooling pads clean and fully wetted.

Tip 6. Monitor and maintain wind-speed and full tunnel static pressure.

First, as an overview, it's helpful to understand how birds handle heat and what kind of help they need to cope with high temperatures and humidity. Our biggest challenge is with fully-feathered birds at or near maturity. A mature broiler in still air needs to shed approximately 12 BTU/hour/pound to keep its internal body heat from rising to the point of heat stress. At around 68-70°F and 50% relative humidity, the bird

Air Velocity = Weight Gain

		Week 4	Week 5	Week 6	Week 7
		---------Body Weight Lbs---------			
Air Velocity (fpm)	0	2.96	4.24	5.32	6.10
	400	3.00	4.44	5.81	6.92
	600	3.02	4.49	5.92	7.22

7.22 - 6.92 = 0.3 lbs more weight per bird at 600 fpm. In a 20,000-bird house, 0.3 lbs x 20,000 x $0.05 = $300.

How important is air velocity? This data from carefully controlled research shows that at week 7 in hot weather, tunnel airflow at 600 fpm produces enough more broiler weight gain to pay out at least $300 per house more than airflow at 400 fpm. See inside for more details.

can pretty much take care of itself, shedding about 5 BTU/hour/pound off the skin surface and 7 BTU/hour/pound from respiration. If the temperature goes up we can usually keep the bird comfortable by adding wind-speed. If temperature continues to rise we add evaporative cooling to reduce actual air temperature.

However, when both temperature and humidity are high, it is much more difficult to remove the heat from the bird. The bird's respiratory system is not as efficient in humid air, and neither are our cooling pads. So when it is hot and humid, it is critical to maintain maximum house airflow and maximum cooling pad efficiency. Now, more details:

Tip 1. Keep fan shutters, blades and fan guards clean.

Research shows that if shutters and blades are allowed to become caked with dust, fan performance can be cut by as much as 30%. This means that fans delivering 600 fpm when clean may deliver only 420 fpm when they are dirty. This results in cutting the wind-chill cooling effect almost in half, from around 15 degrees F to only about 8 degrees of cooling. These are realistic numbers. Without proper fan maintenance, conditions will be nowhere near optimum and bird growth rate and feed conversion will be greatly hurt. To do: Clean fan shutters on a weekly basis. A simple dusting off with a softer bristle push broom will often do the trick. Clean fans at least once per flock.

Tip 2. Replace fan belts and pulleys before wear has an effect on rpm's.

The fan belt and pulley together make up in effect a gear ratio that determines fan rpm. As a fan belt wears, it becomes thinner and rides deeper in the pulley than when new. This essentially changes the gear ratio, resulting in less air movement. The effect is exactly the same as installing a smaller motor pulley: the fan rpm speed is reduced. The same thing happens with a worn pulley, of course. Field studies have found a surprising number of farms where growers kept fan belts tight but the fan rpm's were reduced by 10% or more because the pulleys and the belts were worn. How serious a problem is a 10% loss in air velocity? For example, at 600 fpm, the estimated wind chill cooling will be 15 degrees F. A 10% drop to 540 fpm wind speed produces only about 12 degrees of wind chill cooling, a significant 3-degree loss. Tightening a worn belt does not cure the problem. To maintain maximum wind-chill cooling, replace fan belts and pulleys before wear reduces the rpm's.

Tip 3. Make sure there are no restrictions on tunnel airflow.

Poultry houses and ventilation systems are designed for a certain cfm airflow and fpm airspeed capability based not only on fan capacity but on specified air inlet sizes and on a given house cross-sectional area (which defines the "tunnel" through which air flows from the inlets to the fan end of the house). If, as we have seen too often in the field, tunnel inlet curtains or doors fail to open fully, or brooding curtains or curtain baffles are allowed to hang down too low, the ventilation system cannot achieve the cooling capability it was designed to deliver (and the grower paid for). It's easy to overlook such details as tunnel inlet openings or how low brood curtains are hanging; but on the other hand it is easy to get these details right, and doing so will pay off in better bird cooling.

Tip 4. Eliminate all air leaks.

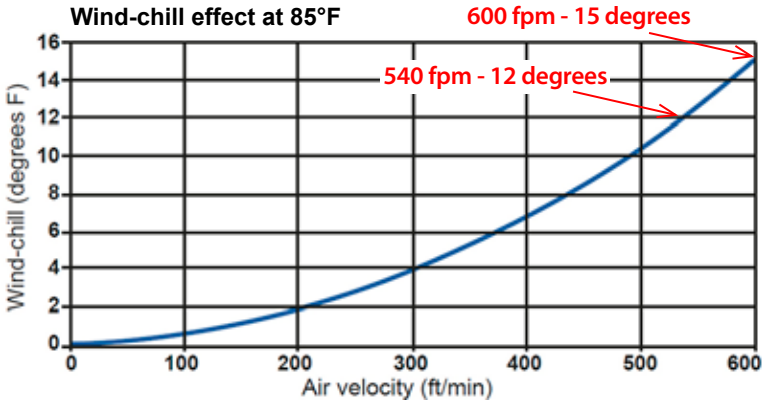
Tunnel ventilation means having all ventilation air come in through designed inlets at one end of the house and going out through fans at the other end. If any significant amount of outside air comes in anywhere except those designed inlets, tunnel air velocity drops and wind-chill cooling is reduced. What might seem to be insignificant cracks or gaps, say along an uncaulked sidewall sill plate, can quickly add up. A one-eighth inch crack that runs 100 feet is the same as a one square foot hole in the wall. Further, if we really need maximum cooling and have evaporative cooling turned on, any air leakage lets uncooled outside air come in, so that much of the evaporative cooling we paid for is lost.

We have recently seen quite a few leaky dog-house pad rooms allowing hot air to bypass the cooing pads. It really

When pulleys or belts are worn, belts ride low in the motor pulley, as shown at left. Result: blade rpm's are greatly reduced, thus robbing cfm's, air speed and wind-chill cooling. Belts should be tight and ride high in the motor pulley, as shown at right, to achieve maximum fan rpm's and best wind-chill and evaporative cooling.

Just How Important is Airflow?

The graph at right shows approximate wind chill cooling for birds above 5 lbs weight in 85°F air. Note that the curve is not a straight line. At higher wind speeds a slight loss in fan performance causes drastic changes in bird cooling. A 10% drop in air velocity, from 600 fpm to 540 fpm, will reduce wind-chill cooling effect from 15 to 12 degrees.



Research shown in the chart on the front page, done at Mississippi State University by Dr. Berry Lott, also shows the critical importance of air velocity. Starting from the same point, male broiler birds were reared from 3 weeks to 7 weeks in still air, 400 fpm air, and 600 fpm air. Each batch of birds was kept in a controlled 24-hour cyclic temperature of 77-86-77°F, simulating summer weather conditions. Notice that these birds were not being reared in optimum thermometer temperatures. The research setup was designed only to test how important wind-chill cooling is, with temperatures controlled at 77°F during the night and 86°F during the day, and no evaporative cooling was used. In other words, at these temperatures, wind-chill effect alone was adequate to get good performance if air velocity was high enough. When temperatures go above the mid-80s, you definitely need the additional real temperature drop from evaporative cooling to keep birds growing.

Just How Important is Evaporative Cooling?

What happens in hot weather if good air velocity is maintained but the evaporative cooling system is neglected and doesn't perform as designed? Other research done by Dr. Lott indicated that if birds were grown at the same wind speed, but with one group at a constant 81°F and the other at a constant 86°F, the birds grown at the higher temperature would be about 20% lighter in weight. These are not real world summertime conditions, but they do provide a basis for a reasonable expectation that a cooling system allowing temperature to run +5 degrees F warmer than normal during the heat of the day would be likely to cost us about 6% of the birds' body weight. How much would that cost the grower? In a house growing 20,000 birds to 7 lbs, a 6% loss in weight would be 8,400 lbs. At $0.05/lb grower pay that is a $420 per house price for not keeping cool pads in top shape. There would also be a loss due to a drastic reduction in feed conversion, which we are ignoring here for the sake of this simplified example.

pays off to do a smoke test to spot and stop any air leaks through wall cracks, around doors, perimeter inlets not fully closing, sidewall curtain gaps, etc. A house tightness test between flocks, closing the house and running one tunnel fan (to be precise, 1 cfm per square foot), should produce a static pressure reading of at least 0.13 to 0.15 inches.

Tip 5. Keep cooling pads clean and fully wetted.

Like fans, evaporative cooling systems are expensive items that pay off by helping keep birds in optimum growth conditions. But you can't get the benefits you paid for unless you do what's needed to keep your cooling pads operating at top efficiency. Any dry area on a pad is the same as an air leak in the house, allowing hot air to come in without being cooled. To maintain maximum cooling, inspect and clean pad systems once a week.

Inspection includes checking filters, pump screens, and distribution header holes in recirculating systems, to make sure water is flowing properly. Pads must also be kept clean so that flute holes don't clog up. One of the best ways to unclog channels in a cooling pad is just to spray a lot of water on them. Use normal water pressure only. High pressure systems can cut or damage pads. Several products are available that help loosen dirt on pads. These are normally sprayed onto the pads with a garden type sprayer or a hydrofoam applicator, or poured directly into the cooling sump and recirculated over the pads and allowed to soak. Follow directions on bottle. Then loose material can be flushed out with just plain water. Be certain that whatever material you use to clean your pads does not contain chlorine and is approved for use on the pads without voiding the pad warranty.

In addition to collecting dirt and dust, pads can also become clogged with algae. If you see green growth, use a manufacturer approved algaecide agent only. Contact the manufacturer of your pad for assistance in selecting a cleaning agent. Pad manufacturers recommend either dumping the water from the sump tank at least once a week or maintaining some type of water bleed-off when the pump is on to maintain clean water. Another step needed to prevent algae growth is to flush or clean water filters weekly. Dirty filters greatly reduce the amount of water flowing to the pad and reduce cooling. Also, remember cooling pads need to be dried out at least once each day. Normally, turn pads off between, say 10 pm and 9 am, so that they are allowed to dry out during the night. If pads become too difficult to clean, it's probably time to consider replacing them. We have witnessed growers get-

ting an increase of close to 100 fpm of wind-speed in houses by replacing old worn out pads that were restricting airflow. If pad replacement is in order, consider that 6-inch recirculating pads are about 75% efficient vs 55% for 2-inch spray pads, and provide about 4-5 degrees more cooling.

Tip 6. Monitor and maintain wind-speed and full tunnel static pressure.

This is the master tip, or we might call it the "all of the above" tip, in that the word maintain takes us back to tips 1-5, which are the more detailed how-to tips. So the key word here is monitor. You won't know whether you are getting top performance from your ventilation system unless you are regularly monitoring and actually measuring its performance. Air velocity (at bird level) is critical, and there are relatively inexpensive wind-speed gauges you can use to check it. Full tunnel static pressure, measured about 20 feet forward of the first tunnel fan, is a good indicator of how much work the fans are having to perform. To measure fan end static pressure, a portable magnahelic gauge is needed, and most service techs have access to and are trained in the use of that gauge. This reading will typically be 0.01 to 0.03 higher than the reading taken at the middle (control room) of a house with dropped ceiling, but is variable, especially with higher wind-speeds and/or high ceiling houses with air deflectors.

There is no one full tunnel static pressure that is right for every house. You want to know what the full tunnel static pressure was when your house and equipment were new and performing as designed, or at least what the pressure reading is when you have done all you can to get the house and equipment in top shape. And you don't want to see that static pressure rising. Abnormally high fan static pressure signals loss of airflow and loss of cooling capability. As design wind-speeds for tunnel houses have increased over the years from 400 fpm to 500 fpm and even to 600 or 700 fpm the total operating pressure on the fans has increased, because the resulting work required for the fans to pull the air into and then exhaust the air out of the house on the fan end has increased. Ten years ago in a 400 fpm tunnel house it would have been common to measure fan static pressure in the 0.08 inches of water column range while in a modern 600 fpm house the total fan pressure might be around 0.15 inches.

The key point is that if you see full tunnel static pressure going up, figure out why it has changed and do something about it. Higher than normal static pressure at the fan end reduces the airflow available for cooling.

The Bottom Line

We have documented instances during field visits where growers thought they were getting maximum airflow and were surprised when checking showed abnormally high static pressure at the fan end of the house. Some of these growers were able to increase full tunnel wind-speeds by 100 fpm or more by taking these tips seriously: tightening up the house, removing air restrictions, cleaning cooling pads, cleaning fan shutters, blades and guards, and/or replacing worn fan belts or pulleys with new ones. Time spent executing these six steps could be money in your pocket.

U.S. Poultry & Egg ASSOCIATION

NPTC National Poultry Technology Center AUBURN UNIVERSITY

AP&EA

ALABAMA COOPERATIVE Extension SYSTEM

The Poultry Engineering, Economics and Management Newsletter provides up-to-date information on topics of interest to poultry production personnel, focusing on most effective and efficient uses of modern technology and equipment, with a special emphasis on economic implications. The Newsletter is published six times a year, or as needed to address emerging or special issues. Contact: Jess Campbell, National Poultry Technology Center, 226 Corley Bldg., Auburn University, AL 36849-5626, (334) 844-3546, fax (334) 844-3548, jesscamp@aces.edu. Published by:

Jess Campbell, Program Manager, National Poultry Technology Center

Dennis Brothers, Poultry Housing Specialist, National Poultry Technology Center

Jim Donald, Professor and Extension Engineer

Gene Simpson, Professor and Extension Economist