The ***Alabama Poultry Engineering and Economics***

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Feature article

Keys to Getting Good Performance from Your Evaporative Cooling System

Summertime is just around the corner, and smart growers and live production people are starting to check up on their houses' ability to cope with hot weather. Most of our industry has moved or is moving to pad cooling to keep birds eating and growing through summertime heat, and for good reasons. But it is a relatively new technology to many growers, and we are getting lots of calls and questions on the topic. This newsletter focuses on the key items that really make a difference in getting good cooling in pad-type houses.

The first requirement for good cooling is, simply, airflow. Pad cooling is complementary to tunnel ventilation and depends on that large-volume airflow to accomplish its job of cooling incoming air. Also, we need good tunnel airflow to exhaust in-house heat build-up and provide wind-chill cooling. In really hot weather, it's the combination of tunnel airflow and evaporative cooling that makes the difference. Fully-feathered broilers perform best in still-air temperatures in the low 70s. If it's 95°F outside, a high-efficiency pad system may be able to reduce air temperature by about 12 degrees, say to 83°F. The tunnel airflow then can give us another 10 degrees or so of wind-chill equivalent cooling, so the birds perform as if they were in a still-air temperature of about 73°F.

Adequate airflow is the foundation requirement for good cooling

So the first thing to check up on is the adequacy of the tunnel ventilation system. If you have a pad-cooled house that is having hot weather problems, don't be too quick to jump to the conclusion that the pad system is the problem. Here are the key points to check to make sure airflow is sufficient:

Most tunnel houses should have fan capacity between 8 and 10 cfm per square foot of house, delivering an in-house air speed of 500 fpm. And that means functioning fan capacity, not just a design specification. In other words, shutters must be clean and belts must be tight. Dirty shutters can cut airflow by 30%. A 15% belt slippage means a 15% reduction in airflow. And the house must be tight. In fact, tightness of houses is one of the biggest things we fight in doing a good job ventilating. Curtains leak from one end of a house to the other and we must do everything possible to stop air leaks and tighten up the house. A good test is to run one 48-inch fan with everything in the house closed. If we can achieve at least a 0.10 static pressure with one fan running, this shows that the house is tight enough to do a good job ventilating.

A tight house is essential – also make sure dirty shutters or loose belts aren't robbing airflow

When the cooling system is turned on, it's essential to make sure tunnel curtains aren't blocking airflow into the house, and that all incoming air is actually coming through the pads. If we have a pad room, we need to be sure that no hot air is being drawn into the house through the ceiling of the pad room.

In looking at the pad system itself, the first thing is to make sure the pads are clean and not plugged. The second item to check up on is pad wetting. Any dry spot on a pad is robbing us of cooling and is letting hot air into the house. We need to make sure the system is putting out enough water to start with, and that water is being distributed properly so that pads are thoroughly wetted at all times.

On fogger or spray-pad type systems we have to be concerned about water runoff, but we also need to be certain that the total pad is covered with water and that we are not getting a lot of dry spots. Running the pad with dry spots or inadequate water is the same as having a hot air leak into the house. So common sense would tell you that if we want maximum cooling from our systems, we have to cover the pad with water. Fogging nozzles are prone to clogging, and we must have a program to check nozzles regularly and clean them whenever needed.

To get all the cooling we paid for, we must make sure all incoming air is coming in through thoroughlywetted pads

With a recirculating system, probably the single most important factor is making sure the small holes in the spray bar located above the pad are not plugged and continually allow water to flow across the pad. If pads are continually streaking and not thoroughly wetting, then we need to clean the distribution system.

With either system type, flushing and cleaning pads before each flock during hot weather is a good insurance policy to make sure that we get optimum airflow and cooling in the house. This is true for all types of pad, 2-inch, 4-inch, 6-inch, and even some of the pads that are not made of paper. Caution: chlorine type cleaning products will damage paper pads. One popular cleaner is a product called Evap 100.

Regular maintenance , checking nozzles, water systems and pads, is essential to good cooling performance

For those with problem houses still not cooling adequately even when all of the above items check out – or for those just planning to install evaporative cooling – here is a quick run-down on how pad type and installed pad area affect system operation and cooling performance.

The first thing to be aware of is that pad systems are designed for a certain cooling capability or efficiency. Typical system cooling efficiencies run from around 50% to 75%. For example, where a 75%-efficient system may under typical conditions be able to achieve 12 degrees of cooling, a 50%-efficient system would reduce air temperature by only 8 degrees. So it's important to know what we are dealing with, or what we are buying, in the case of a new system. We can't demand 12-degree cooling from a system that is designed and installed to deliver only 8-degree cooling. The cooling capability of a pad system depends primarily on three related factors: 1) pad type; 2) installed pad area; and 3) air velocity through the pad.

Cleaning pads at least between flocks is important – but don't use anything containing chlorine

The table on page 3 gives sample specifications for pad type evaporative cooling options for a typical 40 x 500-foot broiler house in Alabama with a total fan capacity of 190,000 cfm. The table shows four different types of cooling pads on the house. For each type, the table gives pad area and air velocity needed for given realistically achievable system efficiencies, along with the approximate static pressures that might be observed in a properly designed house. Note that numbers given in the table (for static pressure and other factors) are based on actual field conditions and might vary slightly from manufacturer's recommendations.

Efficiency of a pad cooling system depends on pad type, pad area installed, and air velocity through pads

A key point to keep in mind is that air velocity and pad area go hand in hand. For a given installed house fan capacity, less installed pad area means higher air velocity through the pads. The only way to get lower air velocity through the pads is to have greater installed pad area. The formula for determining total pad area required is:

Installed fan capacity (cfm) ÷ Recommended air velocity through pads (fpm)

For any type of pad, lower air velocity produces higher cooling efficiency. But different pad types have very different cooling efficiency characteristics. Note that the table recommends 55 feet of 6-inch small-flute recirculating pad on each side of a house, but 70 feet of 2-inch fogger pad on each side. Why do we need so much more 2-inch pad? That's because the 2-inch fogger pad requires much lower air velocity for comparable efficiency.

The two graphs on page 3 show the kind of air velocity trade-off we have to make in order to get best possible efficiency out of a pad at an acceptable static pressure drop. For a typical 2-inch spray-on pad system, 280-310 fpm air velocity through the pad will give a cooling efficiency around 60%, and create a static pressure drop of under 0.05 inches. A 6-inch small-flute recirculating pad, on the other hand, will deliver higher efficiency at higher air velocity, still at acceptable static pressure (75% at 335-350 fpm and about 0.06-0.07 inches sp).

High cooling efficiency requires greater pad area, to get lower air velocity through pads

If we don't have enough cooling pad on a house, so air velocity through the pads is too high, we not only lose cooling efficiency. Our house fans will have to operate at higher static pressure, and the airflow that these fans deliver will be reduced. When the airflow is reduced then the air speed in the house is reduced and wind chill cooling effect is also reduced. So not having enough pad on a house not only affects the evaporative cooling but also affects the wind chill cooling that is one of the key components of tunnel ventilation. *The most common design problem we see in installed pad cooling systems is insufficient pad area.* If you follow the recommendations in the table you will not have a house that is short on pad.

EXAMPLE SPECIFICATIONS FOR PAD EVAPORATIVE COOLING OPTIONS

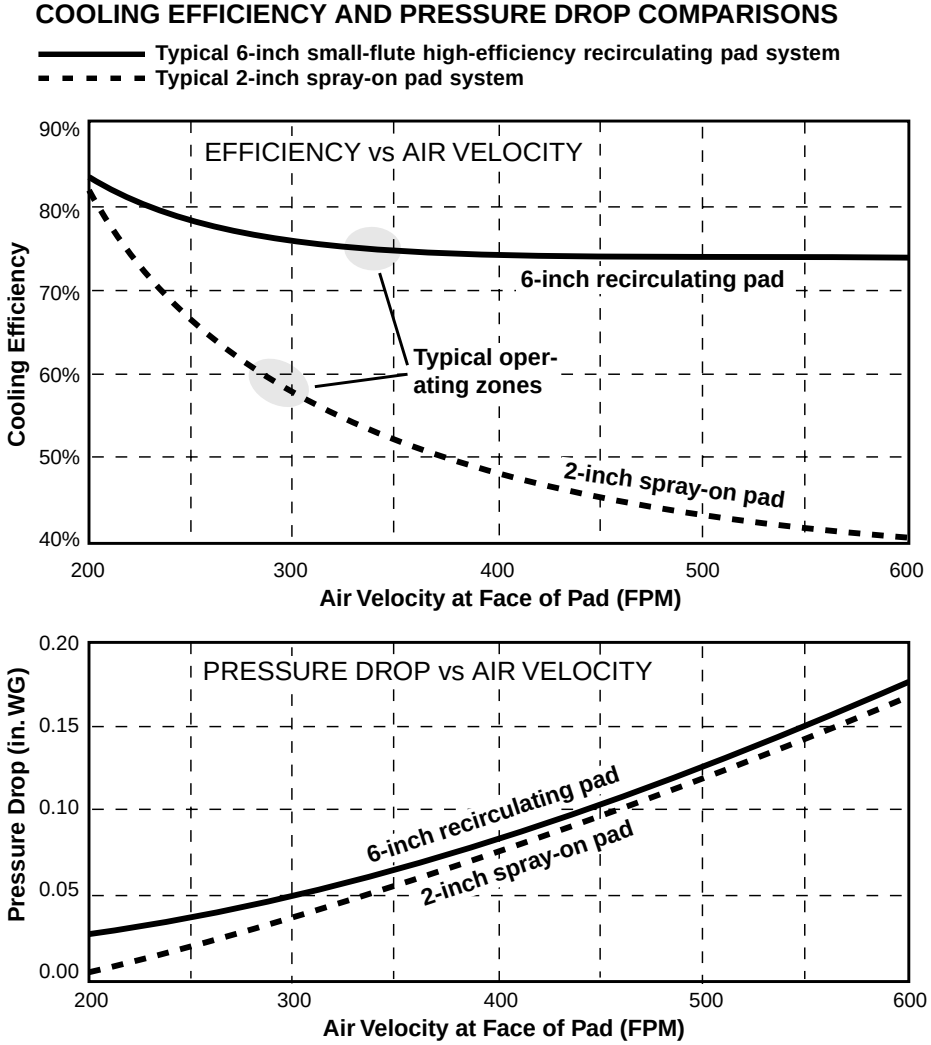
Ranges shown are based on data from several manufacturers, for installation in a 40 x 500 ft broiler house in Alabama with total fan capacity of 190,000 cfm. Exact performance will depend on specific characteristics of brand of pad and system installed.

Pad type and thickness	Design air velocity through pad	Static pressure drop across pad	Total house static pressure[1]	System efficiency	Total pad area needed	Min. length of 5-ft pad on each side of house
6-in small-flute recirculating	335-350 fpm	0.04"-0.07"	0.06"- 0.09"	72-74%	567-542 sq ft	55 ft
6-in large-flute recirculating[2]	335-350 fpm	0.03"-0.04"	0.05"-0.06"	54-62%	567-542 sq ft	55 ft
4-in recirculating	250-300 fpm	0.06"-0.09"	0.08"-0.10"	68-74%	760-633 sq ft	75 ft
2-in spray pad	280-310 fpm	0.03"-0.05"	0.05"- 0.07"	55-66%	679-612 sq ft	70 ft

[1] Poultry house configurations and conditions vary (including ceiling height, use of baffles, arrangement of equipment, cleanliness of fans, pads and shutters, etc.), and therefore total house static pressures will vary.

[2] Six inch large-flute pads operate at lower static pressure than six-inch small flute pads, but provide much lower cooling efficiency. Several major pad manufacturers do not recommend the large flute pad for use on broiler houses.

COOLING EFFICIENCY AND PRESSURE DROP COMPARISONS



Choosing a cooling pad system involves trade-offs of cooling efficiency, static pressure, and required pad area. As air velocity through a cooling pad goes up, efficiency goes down and static pressure drop increases. To get lower air velocity, for higher efficiency and low static pressure, more pad area is needed. Total house static pressure drop should be kept below 0.10 inches.

Six-inch small-flute high-efficiency recirculating pad systems typically achieve above 70% cooling efficiency and acceptable house static pressures with design air velocities between 335-350 fpm. To get close to comparable efficiency with a 2-inch spray-on system, air velocity must be lower, typically 280 fpm or slower.

Curves in this illustration are intended to show the typical relationships among these factors for two representative pad systems. Particular systems will have similar curves, but growers should consult and compare actual efficiency and pressure drop curves from individual manufacturers before making equipment decisions.

What is the $ value of a topnotch evaporative cooling system to a broiler producer?

It's clear that the entire industry has found investment in cooling equipment to be worthwhile — virtually all tunnel houses in the U.S. now have some sort of cooling system. But let's try to put some conservative value on the benefit of having not just "some sort of cooling," but a Class-A, well-designed and properly operated pad cooling system. A lot of C-grade systems will get us by during moderate weather. It's when we have big birds and the temperature gets near 100 degrees F and stays there for a while when we see what the good system will do and that's where we should try to put the value on the system.

Top quality cooling systems pay off by keeping big birds alive and growing even during very hot weather

Field observations of different houses in the same complex suggest that a top-quality cooling system can save a great deal of money just by preventing mortalities. Granted, there is no system that will totally take the weather out of the broiler business. But during extremely hot weather, Class-A cooling houses are seen to have at least a 3% advantage over average-or-below houses in preventing mortalities. Over at least two growouts per year in hot weather, that can save almost $400 per house just on a per-bird basis:

3% x 24,000 birds x 6 lb. bird weight x $0.045 grower pay per lb. x 2 growouts = $389

Over 10 years that's a saving of almost $4000/house. Remember, this is just the per-bird benefit. A loss of that much flock weight so late in the growout would also hurt feed efficiency and therefore grower ranking, bringing the risk of receiving less pay per pound for the entire flock because of the weight loss. Also, the calculation assigns no costs to the grower who has to get rid of the extra mortalities. It does not include any dollar value for increased bird performance in the topnotch house. And it does not take into consideration that the more efficiently cooled house is likely to have a lower electric bill.

The fact is, during hot weather houses with top quality cooling systems always outperform their neighbors who do little or no maintenance or don't have the pad area and/or water to do the job. And in extreme heat a house with a topnotch cooling system can save a grower hundreds or thousands of birds. *The value of proper cooling system design and maintenance is something to think about!*

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Update: Newsletter & Website

The response to our newsletter has been good. We welcome your comments and would be pleased to have your suggestions for future newsletter topics. Also, we would like to call your attention to the new Internet website on poultry ventilation. To get there, point your browser to *http://www.acesag.auburn.edu/poultryventilation*. All newsletters will be maintained on this site, as well as copies of our most pertinent poultry ventilation publications.

Reminder: Grower Educational Seminar Planned

Alabama Poultry & Egg Association will offer a seminar for growers at its annual meeting on Saturday, June 3, at 3:30 p.m. at the Birmingham Sheraton. Titled "Managing Ventilation Systems for Temperature Control and Maximum Pay," the presentation will focus on the practical understanding growers need to achieve the best possible temperatures for optimum returns. For more information on the meeting and seminar, call 800-254-2732.

ALABAMA COOPERATIVE Extension SYSTEM

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