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Poultry Housing Tips

Pad System Cooling, Installation and Management

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Overview

Pad Area:

In order to insure maximum bird cooling during hot weather, it is crucial that evaporative cooling pads are properly sized. Pad area should based on the total amount of air moved by the tunnel fans, not the size of the house (Table 1). The greater the fan capacity of a house, the more pad required. If not enough pad is installed in a house, the amount of air the fans move will be decreased. As the amount of air the fans move decreases, wind chill decreases and the temperature difference between the pad and fan ends of the house will increase. For instance, if we reduce the pad area by 25% in a tunnel ventilated house with fogging pads the cooling produced by the pads will be reduced by 20%, air flow will be reduced by 10% or more, the wind chill effect produced by air moving down the house will be decreased three degrees or more, and the temperature difference at the fan end of the house can increase by as much as 20% (Table 2).

Type of Pad	Minimum recommended pad area	Static Pressure
2" pads (45^O X 45^O)	**1 square foot for every 325 cfm of exhaust fan capacity**	**0.085"**
4" pads (45^O X 45^O)	**1 square foot for every 250 cfm of exhaust fan capacity**	**0.085"**
6" pads (45^O X 15^O or 30^O X 30^O)	**1 square foot for every 375 cfm of exhaust fan capacity**	**0.085"**

Table 1. Minimum Pad Area

Type of Pad	Cooling Decrease	Static Pressure Increases to
2" pads	**20%**	**0.12"**
4" pads	**4%**	**0.12"**
6" pads	**7%**	**0.12"**

Table 2. Effect of Reducing Pad Area 25%

Temperature Reduction:

The amount of cooling produced by a pad depends on type of pad as well as outside temperature and relative humidity. In general, 4" and 6" pads produce about the same amount of cooling while 2" pads produce slightly less cooling. The biggest difference in cooling produced by the different systems occurs during extremely hot and dry weather. For instance, when it is 80^0F and 70% relative humidity, the 6" pad will produce about 1.5^0F more cooling than the 2" fogging pad. But when it is 100^0F and 30% relative humidity, the difference between the two systems will be more than 5^0F (see charts 1 and 2).

	Relative Humidity								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
70 F	52.6	52.3	57.2	59.5	61.7	63.2	64.7	67.0	68.5
75 F	56.0	58.6	61.1	63.7	66.0	67.9	69.7	71.6	73.5
80 F	59.4	62.3	65.0	68.0	70.2	72.5	74.7	76.2	78.5
85 F	62.6	65.9	68.9	71.9	74.5	76.7	79.4	81.2	
90 F	65.9	69.6	72.7	75.7	78.7	81.0	84.0		
95 F	69.2	73.2	76.6	80.0	83.0	85.6			
100 F	72.2	76.7	80.5	84.2	87.2				
105 F	75.6	80.2	84.7	88.5					
110 F	78.9	84.0	89.0						

Chart 1. Incoming air temperature (F) under various outside conditions (Properly sized 4" or 6" pads)

	Relative Humidity								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
70 F	57.2	57.0	60.6	62.3	63.9	65.0	66.1	67.8	68.9
75 F	61.1	63.0	64.8	66.7	68.4	69.8	71.1	72.5	73.9
80 F	64.9	67.0	69.0	71.2	72.8	74.5	76.1	77.2	78.9
85 F	68.6	71.0	73.2	75.4	77.3	78.9	80.9	82.2	
90 F	72.3	75.0	77.3	79.5	81.7	83.4	85.6		
95 F	76.1	79.0	81.5	84.0	86.2	88.1			
100 F	79.6	82.9	85.7	88.4	90.6				
105 F	83.4	86.8	90.1	92.9					
110 F	87.2	91.0	94.6						

Chart 2. Incoming air temperature (F) under various outside conditions (properly sized 2" fogging pads)

For every 1^0F of cooling, relative humidity will increase approximately 2.5%

Flute angles:
Four-inch pads typically come in one flute angle configuration, 45^0 X $45^{0,}$ while 6" pads come in two flute angle configurations, 45^0 X 15^0 and 30^0 X 30^0. Both types of 6" pads produce the same amount of cooling. The biggest difference between the pads is the amount of water which flows over the air entering face of the pad. With 6", 45^0 X 15^0 flute angle pads, the 45^0 flutes slope down toward the air entering face of the pad (outside surface), while the 15^0 flutes slope down towards the air exiting face of the pad (inside surface). This configuration significantly increases the amount of water flowing over the outside surface of the pad and minimizes the water on the air inside surface of the pad. Water flowing over the outside surface of the pad helps to minimize mineral build-up and pad streaking, thereby increasing pad life. With 30^0 X 30^0 flute angle pads, the flow of air through the pads tends to push more water toward the inside surface of the pad which can lead to a slightly dryer outside pad surface and slightly reduced cooling during extreme conditions.

Edge Coatings:
Edge coatings serve many purposes. First, surface coatings make it easier for water to flow along the outside edge of the pad surface thus helping to keep it clean. Coatings can also strengthen the outside surface of the pad enabling it to hold up better when being cleaned. Last but not least, coatings tend to make it harder for algae to take root into the fibers of the pad, thereby making it easier to clean algae from the pad.

Water distribution systems:
To insure that the entire pad remains wet and clean, it is vital that there is adequate water flowing over the pad. In general, it is recommended that the water distribution system be capable of circulating a minimum of 0.75 gallons per minute for every linear foot of pad. Therefore, if you have a 50' pad system, the water circulation pump should be capable of circulating 37.5 gallons per minute (50 X 0.75 = 37.5). With most distribution systems, this means when the top cover is removed the water should spray up about 14" to 18". It is important to realize that, at most, only about 10% of the water flowing over the pad is evaporated.

Installation

Doghouses:
For best results, evaporative cooling pads should be installed at least two feet out from the side of a house. “Doghouses” allow for access to both sides of the pads to make it easier to clean the pad by eliminating the need to remove the pads from the system for cleaning. It is important to note that even with the utmost of care, every time a pad is taken out of the system, damage is done to the top and bottom of the pad. This often leads to water leaking from the system. Doghouses also allow easy access to the tunnel curtain and eliminate water from the distribution system from entering the house. When building a doghouse, make sure that the structure is airtight. If care is not taken, tunnel fans can pull air from the house attic, significantly reducing the cooling produced by evaporative cooling pads.

Circulation pump location:
To maximize water distribution uniformity, the circulation pump should be located in the center of the pad system. With longer pad systems, more water is often circulated on the pads nearest the pump than is circulated at the end of the system. By placing the circulation pump in the center of the system, water distribution becomes much more uniform and the flow of water back to the circulation pump is improved. Furthermore, with the installation of shut-off valves, producers can conveniently turn off half the pad on each side of the house. This will allow the flexibility of providing limited cooling for younger birds, and for older birds during cool or humid weather.

Water supply:
Four and six-inch pad systems can evaporate nearly eight gallons per minute of water during extremely hot and dry weather. To make sure that there is enough water for the pads as well as the birds, it is crucial that the well or municipal water supply is capable of supplying at least ten gallons per minute per house.

Operation

1) Set evaporative cooling thermostats between 82 and 85^{0}F. In most poultry growing areas of the U.S., California and Utah being the exception, when outside air temperature is below 80^{0}F the relative humidity is above 80%, and very little cooling will take place. Setting circulation pump thermostats below 82^{0}F will result in the pad system operating nearly 24 hours a day. This creates excessively humid conditions and leads to caked litter.

2) Do not control pad systems with cycle timers. The constant cycling of the water circulation pump will decrease the life of the pad as well as encourage mineral deposition. Furthermore, cycle timers can lead to significant variations in house air temperature which can have a detrimental effect on bird performance.

3) Do not worry about the temperature of the water in your evaporative cooling pad system. Decreasing the temperature of the water circulating over an evaporative cooling pad by 10^{0}F would only increase cooling produce by the pad by less than 0.1^{0}F.

Pad Care and Maintenance

Algae Control:

1) To minimize algae growth as well as prevent trash, bugs, and dirt from making its way into your distribution system, make sure your sump is covered.

2) Dump water from the sump a minimum of once every two weeks. This will help minimize the build-up of sludge in the bottom of the sump which is the "food" on which algae grows. Furthermore, over time as water evaporates and minerals stay behind, the water in the sump becomes highly concentrated with minerals and ammonia.

3) Make sure the pads are dried out once a day. Since very little cooling occurs between the hours of 11 p.m. and 10 a.m., this is a good time to make sure pads are not operating so the pads can be dried.

4) Shade the pads and sump. Shade cloth extending from the eave of poultry house down toward the ground at a slight angle can help retard algae growth. Make sure that there is at least a 4' gap between the shade cloth and the ground to minimize fan restriction.

5) **Do not use chlorine or bromine to control algae growth.** Chlorine or bromine will significantly reduce the life of evaporative cooling pads. Algae control products containing a quaternary amine (i.e., Evap100, Greenshield, Agri-Cool, etc) are typically viewed as the best for controlling algae without adversely affecting pad life. When in doubt whether a product is appropriate, check with the manufacturer of your evaporative cooling pads. In general, these products should be added to the sump once per week.

Minimizing pad clogging:

1) Clean water filters weekly. Clogged filters reduce the amount of water flowing to the pad which can reduce cooling as well as reduce the life of the pads.

2) Check the speed of the air entering evaporative cooling pads. To maximize cooling, it is very important that evaporative cooling pads are kept clean. Clogged pads can result in large temperature differences between the pad and fan ends of a house, reduced wind chill effect, and increased electricity usage. An inexpensive air velocity meter is one of the best methods of evaluating whether evaporative cooling pads need cleaning. Standing inside the poultry house, place the air velocity meter 1" to 2" from the center of the evaporative cooling pad. For a 6" pad you should find that the air is moving through the pad at a speed of approximately 350 to 400 ft/min (for 4" pads, the air velocity should be approximately 250 ft/min). The lower the air speed the lower the amount of air

entering the house. For example, if the air is only moving through a 6" pad at a speed of 300 ft/min, instead of 400 ft/min, this indicates that you are bringing in 25% less air than you should be. It is very important that fans are cleaned, belts/pulleys are replaced if worn, and the house is made tight before this test is conducted. Low air speeds through evaporative cooling pads can also be caused by poorly maintained fans or excessive air leakage.

3) Make sure the holes in the water distribution pipe are clean to insure that maximum water flow over the surface of the pad can be achieved. Keep in mind that water flowing over the surface of a pad has a negligible effect on static pressure and therefore does not affect the air moving capacity of your fans.

Exhaust Fan Maintenance

1) Replace worn fan belts. Fan belts do not stretch. A fan belt rides in the motor and prop pulleys on its sides. Over time, the sides of the belt wear and as a result it becomes thinner. The thinner a belt becomes, the lower it will ride in the motor and prop pulleys and the slower the fan blades will rotate. The slower the fan spins, the less air the fan will move. It is not uncommon for a worn belt to result in a loss of fan capacity of 25%. Since the relationship between air speed and wind chill is exponential, a 25% loss of wind speed can reduce wind chill of 50%! Keep in mind that even though automatic belt tensioners reduce belt slippage and therefore increase belt life, they do not eliminate the need to replace belts on a regular basis. At a minimum, fan belts should be replaced once a year to insure maximum air moving capacity and therefore maximum bird cooling.

2) Replace worn pulleys. If a producer does not replace loose belts, the slipping of the belt over the motor pulley will cause excessive wear on the pulley. As a result, the motor pulley becomes more “U” shaped rather than “V” shaped. When this happens even a new belt will not ride in the pulleys properly, resulting in reduced air moving capacity. This problem can only be solved by replacing the motor pulley.

3) Clean fan shutters weekly. Dirty shutters make it harder for the fans to move air and can therefore decrease their air moving capacity by 20% or more.

House Maintenance

1) After the fans have been properly maintained, conduct a static pressure test. In houses with evaporative cooling pads, it is essential that all the air enter the house through the evaporative cooling pads and not through cracks in the side wall and ceiling. With one 48" fan operating and the tunnel curtain closed, measure the static pressure. Ideally, the pressure will be above a 0.10" pressure. The lower the pressure, the more air you have entering through the cracks in the house and not the pads. A static pressure of 0.04" or lower indicates that at least one, possibly two, fans are pulling air through the cracks in the house and not the pads. In a study conducted a couple of years ago, this amount of leakage was found to increase the temperature of the air at the fan end of the house by as much as five degrees. Some areas to check for leakage are the top and bottom of side wall curtains, end wall doors and along the top of the side wall. In open ceiling houses check along the ridge cap as well as between the trusses at the side wall of the house. Smoke emitters can be very helpful in locating leaking areas

2) Patch holes in dropped ceilings. The temperature of the air in the attic of a dropped ceiling house during the summer can exceed 130^{o}F. If this hot air is allowed to enter a house through holes and gaps in the ceiling vapor barrier, the temperature difference between the fan and pad end of a house will rise. Keep in mind that it is three to four times easier for air to enter through a hole in the ceiling vapor barrier than through the evaporative cooling pad.

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