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Poultry Housing Tips

Does your evaporative cooling pad distribution system circulate enough water?

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In order to get maximum cooling, as well as, maximum life out of a six-inch evaporative cooling pad system, it is very important that the water distribution system is capable of circulating a minimum of 0.75 gallons/min for every foot of pad system length (GPM/ft). This means, for instance, that a 60' pad section should have a water distribution system capable of circulating a minimum 45 gallons of water over and through the pads each minute. Before you get too concerned, realize that only a small fraction of this water will actually evaporate. In fact, the recommended circulation rate is about ten times the maximum evaporation rate. So why do we need to circulate so much water? First, it is important to keep in mind that unlike fogging pads, with six-inch-pad systems water is only applied at the very top of the pad and as a result it takes a lot of water to insure that the pads get thoroughly wetted all the way to the bottom. Thus, you will find dry spots and/or streaking are more likely to occur in systems where the water circulation rate is below 0.75 GPM/ft. Streaking will, of course, lead to decreased cooling as some of the air entering the house moves through sections of dry pad instead of wet pad (Figure 1).

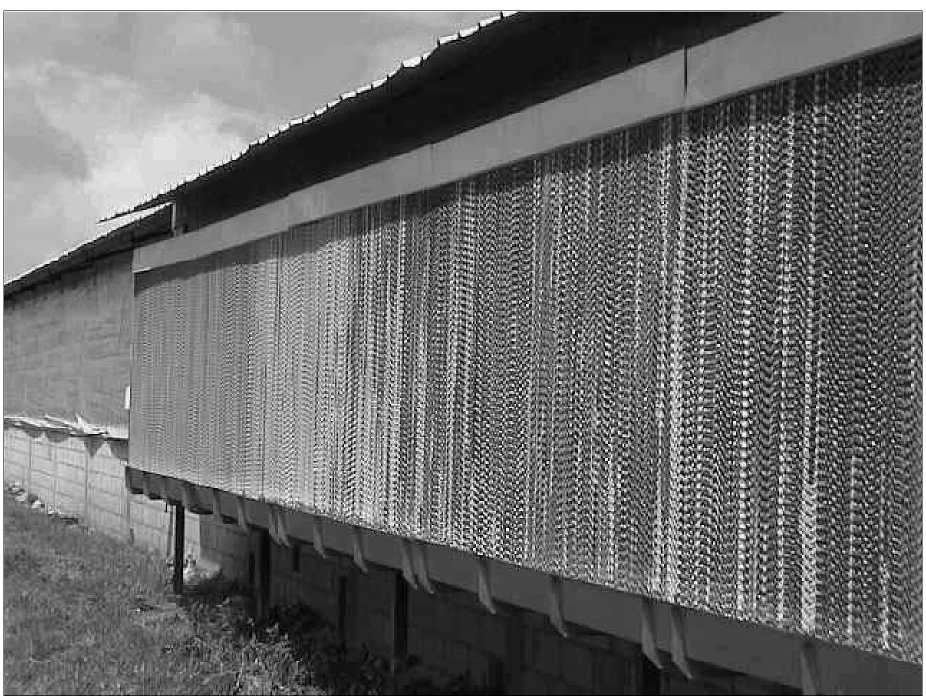

Figure 1. Poor water distribution

Just because your pads appear to be wetting properly today does not necessarily mean you are circulating the proper amount of water. During mild weather, it does not take much water to keep a pad thoroughly wetted because not very much water is evaporating from the pads. But, the hotter it becomes outside the more difficult it becomes to keep a pad thoroughly wetted because the amount of water evaporated off the pad increases dramatically. For instance, on a day when it is 85ºF and 50% relative humidity, approximately 3.7 gallons of water will evaporate off the pads each minute in a typical 500' broiler house. But, when it is 100ºF and 20% relative humidity, water usage will more than double to 8.3 gallons per minute. So water flow that may suffice on a 85ºF or 90ºF day, may not be adequate to prevent streaking on a 100ºF day when evaporation and the need for cooling are at their highest (Figures 2 and 3).

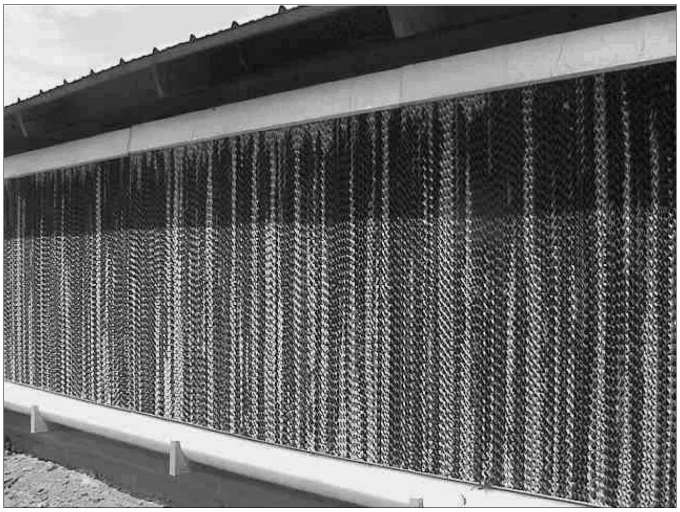

Figure 2. Low water flow.

Figure 3. Proper water flow

Circulating the proper amount of water over a pad not only insures maximum cooling, but helps to minimize dust buildup. Water flowing over the surfaces of a pad actually helps to remove dust from the surface of the pad and to some extent the interior of the pad. It is the accumulation of dust on and within a pad which increases the static pressure the fans are working against. Increased static pressure reduces the exhaust fans air moving capacity, leading to decreased wind chill and larger temperature differences between the pad and fan ends of the house. Furthermore, the dust often contains ammonia which can change the pH of the pads, making them softer over time and reducing their life.

Water flow over a pad also helps minimize mineral buildup. When there is very little water flow over the surface of a pad, mineral deposits are more likely to form on the surface of the pad. Over time, if not removed the accumulation of minerals will make it harder and harder for the exhaust fans to pull air into and down the house. The more water flow you have over the surface of a pad, the more likely that minerals in the water will be kept in suspension and airflow, as well as, cooling will be maximized.

One of the easiest ways check to see if you have sufficient water circulating over your pads is to simply take the top off of your distribution system and measure the height the water is spraying up from the holes in the top of your distribution pipe (Figure 4). How high the water should spray up depends on hole spacing as well as hole size. The smaller the holes or the farther the spacing, the higher the water has to spray up to supply the proper amount of water (see Table 1).

Holes Size and Spacing	Distribution System Manufacturers*	Minimum Water Column Height
1/8" holes - 4" spacing	Munters Aerotech Acme	16"
1/8" holes - 2 3/4" spacing	CoolAir	11"
1/8" holes - 3" spacing	Cumberland	12"
1/8" holes - 2" spacing	Cumberland Hired Hand	8"
5/32" holes - 4" spacing	Choretime Aerotech	6"

*It is important that you actually measure the hole size and spacing in your distribution system. Many manufacturers have, over the years, changed the spacing and/or hole sizes in their systems.

Table 1. Minimum water column height of various water distribution systems

As you can see in the above chart, the height the water sprays up varies significantly from system to system. Increasing the hole size from 1/8" to 5/32" dramatically decreases the height needed because a change of only 1/32" actually changes the area of each hole by approximately 55%, thereby increasing the amount of water coming from each hole significantly. Since the holes are so much larger, the water does not come out as fast (spray up nearly as high) to supply the same amount of water as the much smaller 1/8" hole. From the chart it can also be seen that putting the holes close together also reduces the amount of water column height required to produce 0.75 GPM/ft.

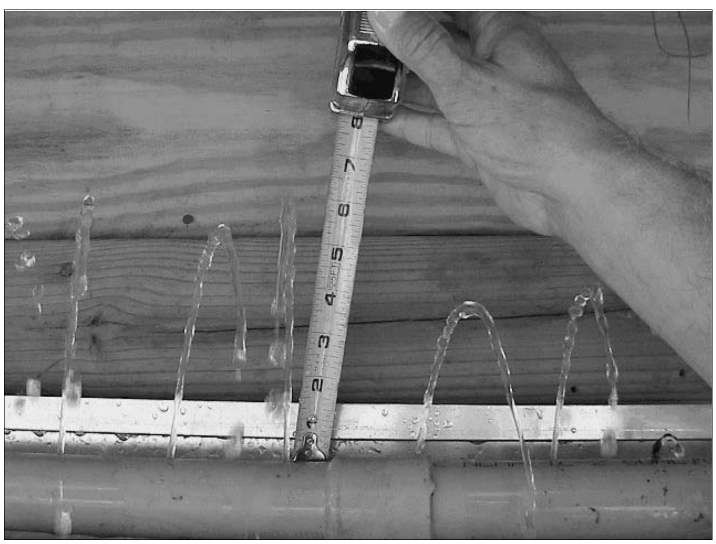

Figure 4. Measuring water column height

Another important aspect of your distribution system you should examine is the uniformity of the water spraying out of your distribution pipe from one end of your system to the other. If you take the top of the distribution system near the pump and then again at the end of the system you will notice the water shoots up higher at the pump end of the system (Figures 5 and 6). This is because the water pressure and flow decrease as you move from the pump to the end of the system. How much it changes depends on a variety of factors such as pipe size, hole spacing, and system length.

In general, the further you move from the pump the lower the water will spray up and the lower the amount of water flowing to the pad. As a result, when checking the water flowing to your pad it is recommended to check at the end of the system where water flow will be generally be the lowest.

Figure 5. Water column height (near pump 70' system)

Figure 6. Water column height (far end of same system)

One problem with longer systems (over 50') is that there can be a large difference in water column height from one end of the system to the other. In these systems you may have over 20" of water column at one end and less than 5" at the far end leading to the possibility of excessive water at one end and insufficient water at the other. One possible solution to this problem is installing a larger pump. The problem is that in order to get proper water flow at the far end of the systems the water pressure may be so high near the pump that water sprays out from underneath the distribution system creating a mess. Furthermore, the larger pump will not only increase initial cost but operating costs as well.

The best way to improve system uniformity is to simply place the pump in the center of the evaporative cooling pad system (Figures 7 and 8). Placing the pump in the center of a system reduces the water flow rate down the distribution pipe which reduces friction and improves the uniformity of water flowing to the pads. For instance, let's say you had a 60' system (2" distribution pipe, 1/8" holes, 4" on center) with the pump installed on the end, you would expect to see the water spraying up 12" at holes nearest the pump and 6" at the far end. Moving the pump to the center of the system you would now only expect to see a variation of less than 2" in water column height and as a result more uniform water flow over and through the pads.

As mentioned previously, water flow uniformity down the length of a distribution system is affected by pipe size. The smaller the pipe the faster the water flows in the pipe and the more difficult it becomes to get uniform water distribution as the pipe length increases. As a result, systems with a 2" distribution pipe will tend to produce more uniform water distribution than systems with 1 ½" diameter distribution pipes. For example, recently two 70' systems were tested in the field. Both systems had the same pump which was located at the end of the system. One system had a 2" distribution pipe (5/32" holes, 4" on center) the second had an 1 ½" distribution pipe (1/8" holes, 2 3/4" on center). In the system with the 2" distribution pipe the water sprayed up 13" at the end nearest the pump and 7" at the opposite end. In the system with the 1 ½" distribution pipe the water sprayed up 13" at the pump and only 2" at the far end, producing noticeably drier pads at the end of the system. Though it would be better to have placed the pump in the center of both systems, it was clear that systems with 1 ½" distribution pipes are more prone to problems when longer than 50' in length.

There are a couple of other advantages to placing the circulation pump in the center of an evaporative cooling pad system. First, by placing the pump in the center of the system the water flowing through the pads returns to the pump faster, reducing the possibility of the pump temporarily running out of water. Another advantage of placing the pump in the center of the system is that cut-off valves can be installed so that with younger birds the producer can turn off on half of the pad on each side of the house. This allows the producer to limit the cooling produced by the pads while maintaining more uniform house conditions which is sometimes a problem when a produce turns off the pads on one entire side of a house. As a result, for systems over 50' in length it is advisable that the pump is placed in the center of the evaporative cooling pad system.

Some other points about evaporative cooling pad distribution systems to consider:

1) In past field studies 5/32" holes where shown less likely to clog under lower water pressure situations than 1/8" holes.
2) When examining a new system check the holes in the distribution pipe closely to make sure that the holes were cleanly drilled and free of trash.
3) Four-inch-thick pads require less water per linear foot to insure proper wetting (0.5 GPM/ft).
4) Pad flute angles can affect the amount of water required to insure proper pad wetting. Though 0.75 GPM generally does a good job of wetting a pad with 45° X 15° flute angles, pads with 30° X 30° flute angles may require more water.

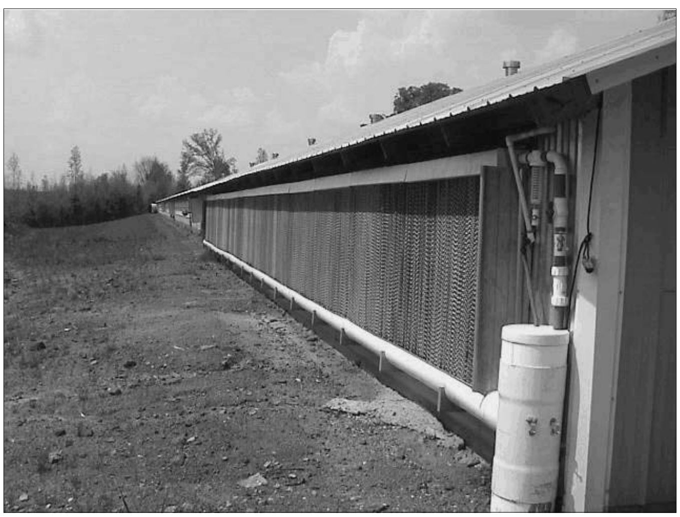
Figure 7. 70' system with pump on end


Figure 8. 60' system with pump in center

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