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Poultry Housing Tips

Using Interval Timers to Control Evaporative Cooling Pads

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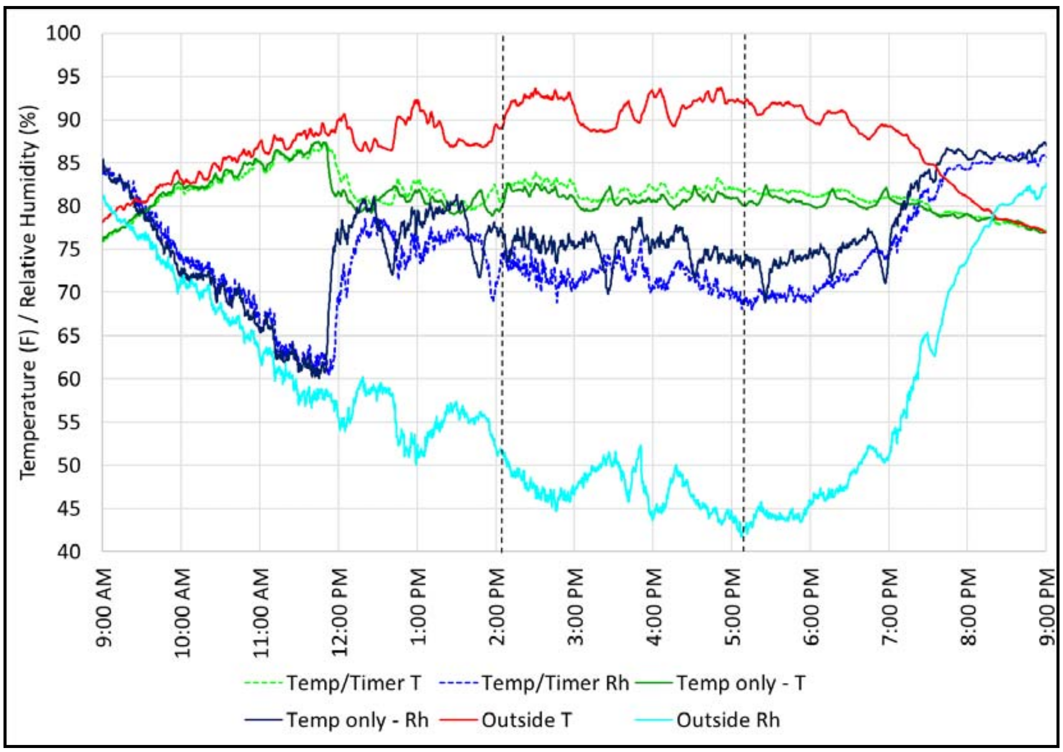

Figure 1. Inside and outside environmental conditions (Day 1)

It is fairly common practice to operate evaporative cooling pads off both house temperature and an interval timer. For instance, the evaporative cooling pad pump would be set to turn on once house temperature reaches 82ºF, at which time an interval timer would allow the circulation pump to operate a minute or two out of ten. Once the house temperature drops below 81ºF, the circulation pump would turn off. The question is whether there is an advantage to operating an evaporative cooling system in this manner as opposed to simply operating the circulation pump solely based on house temperature.

Recently a study was conducted on a commercial broiler farm to compare environmental conditions in side-by-side houses to help answer this question. Three high-accuracy temperature/humidity data loggers were placed inside each of two broiler houses, approximately ten feet from the evaporative cooling pads, near the tunnel fan end of the tunnel curtain opening, on the north side of each house. An outside temperature/humidity data logger was placed 10' from the evaporative cooling pads on north side of each house. A time-lapse camera was placed eight feet from each pad system to provide a record of the level of pad surface wetting. The data loggers were set to record every 10 seconds, 24 hours a day, over the course of the two-day study. The houses were empty and the tunnel fans in both houses were set to operate continuously.

In one house the environmental controller was programmed to turn on the evaporative cooling pad circulation pumps when house temperature reached 82ºF and turn off at 81ºF. In the second house, the circulation pumps operated off a combination of both house temperature (82ºF on / 81ºF off) and an interval timer (2 minutes on/8 minutes off). On the first day of the study, both pad systems were activated shortly just before noon when the outside temperature was approximately 86ºF and were allowed to operate for the remainder of the study if the house temperature exceeded 82ºF .

Figure 2. Evaporative cooling pad at 2:05 pm - Day 1 (temperature only)

Figure 3. Evaporative cooling pad at 2:05 pm - Day 1 (temperature and interval timer)

Figure 4. Evaporative cooling pad at 5:10 pm - Day 1 (temperature only)

Figure 5. Evaporative cooling pad at 5:10 pm - Day 1 (temperature and interval timer)

Day	Temp/Timer House T	Temp/Timer House Rh	Temp. House T	Temp. House Rh	Difference T	Difference Rh	Outside T	Outside Rh
1	81.6ºF	72.3%	80.7º F	75.4%	0.9ºF	3.1%	90.6ºF	48.3%
2	80.3º F	81.6%	79.9º F	83.6%	0.4ºF	1.9%	85.2ºF	66.9%

Table 1. Average daytime inside/outside conditions

On the first day of the study the pad systems in both houses produced a similar level of air cooling (Figure 1). Over the course of the day (1 pm - 7 pm), the incoming air temperature averaged 80.7ºF in the house where the pads were controlled solely based on house temperature, compared to 81.6ºF in the house where the pads were controlled by a combination of house temperature and interval timer (Table 1). The slightly higher level of cooling resulted in a sightly higher relative humidity, 75.4% vs 72.3%. On the second day of the study there was less of a difference in incoming air temperature between the two houses, 79.9ºF vs. 80.3ºF (Figure 6 & Table 1) as well as humidity 83.6% vs 81.6%. The slightly lower temperatures and higher relative humidity in the house where the pads operated based solely on house air temperature indicates that the pads were slightly wetter on average than in the house where a combination of house temperature and an interval timer were used to control pad operation.

The reason that there was so little of difference in the cooling between the two methods of pad control is due to the simple fact that the use of ten-minute timers generally doesn't result in any significant level of pad drying. When wet, the typical evaporative cooling pad is capable of holding approximately 0.6 gallons of water. This means that under hot, humid conditions (95% ,50%) it can easily take over 30 minutes for a pad to fully dry. More importantly, wetted pads will generally tend to produce the same level of air cooling for roughly 10 minutes before a sufficient amount of moisture is evaporated from the pad to start affecting the cooling ability of a pad.

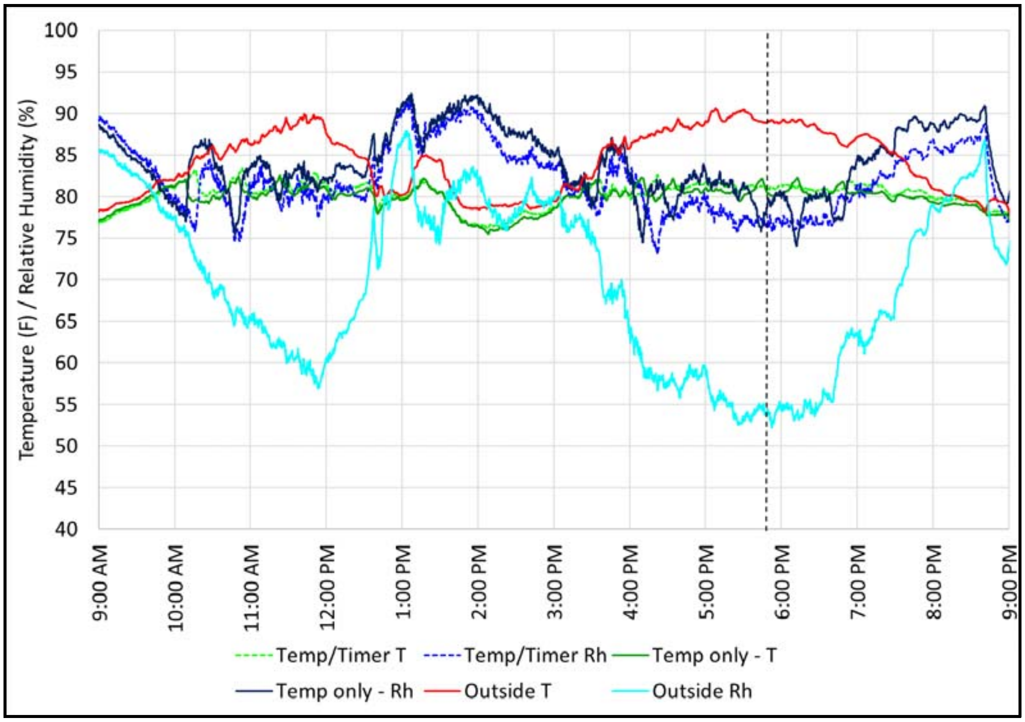

Figure 6. Inside and outside environmental conditions (Day 2 - Rain showers between 12:45 pm and 3 pm)

Figure 7. Evaporative cooling 5:48 - Day 2 (temperature only)

Figure 8. Evaporative cooling pad at 5:48 pm - Day 2 (Temperature and interval timer)

It is important to realize that just because the leading edge of a pad appears dry it doesn't necessarily mean that the pad is producing significantly less air cooling or humidity. Interestingly you could reduce the thickness of a six-inch pad by an entire inch and the cooling produced would only be reduced by less than one degree during hot, humid weather. The fact that the leading edge of a pad can appear dry and cooling would be minimally affected can be seen in Figures 2 and 3 taken at 2:05 pm on the first day of the study. Though the surfaces of the pads on the house controlled by both house temperature and interval timer appear wet, they are producing essentially the same amount of cooling/humidity as the pads that appear dry on the house where pad operation was based only on house temperature (Figure 1). A similar occurrence can be seen at 5:48 on second day of the study (Figure 6), except the surfaces of the pads operating based solely on house temperature appear drier (Figures 7 and 8) but again, the difference in air cooling/humidity is minimal. This of course is not always the case. Figures 4 and 5 show the condition of the pads on the two houses at 5:10 pm on the first day of the study. The pads on the house being controlled by a combination of house temperature and an interval timer are drier, and are in fact producing a little less cooling and as a result less humidity. But, again over the course of the day, there is not a large difference in the temperature and humidity between the two different methods of pad operation.

It is true that had the circulation pump been set to operated less than a minute out of ten, chances are that there would be a greater difference in the incoming air temperature. A shorter circulation pump run time would have tended to result in drier pads, which would in turn would have produced less air cooling and humidity. But, it is important to realize that regardless of how you operate an evaporative cooling pad, you don't get less humidity without producing less cooling. The relationship between cooling and humidity is essentially constant. For every degree of cooling produced by an evaporative cooling pad, the humidity of the incoming air will increase by approximately 2.5%.

Figures 1 and 6 clearly illustrate the relationship between cooling and humidity. On the first day of the study the pad systems were producing approximately 10ºF cooling during the hottest portion of the day (92ºF - 93ºF (outside) vs. 82ºF - 83ºF (inside)) and the relative humidity was approximate 25% higher inside (2.5% X 10ºF) than it was outside. Furthermore, the pad operating off only house temperature was on average approximately 1ºF (0.9ºF) cooler and as expected the humidity was approximately 2.5% higher (3%). On the second day of the study the pad system operating off temperature only was on average 0.4ºF cooler and the humidity was 1.9% higher, which is within 1% of what is expected.

A few points to keep in mind when it comes to evaporative cooling pad operation:

1) Very little actual pad drying typically occurs during the off time of a ten-minute interval timer. During typical hot, humid weather, a wetted pad system will tend to produce the same level of air cooling for around ten minutes after the water circulation pump is turned off. As a result, operating a pad off a ten-minute timer tends to produce minimum pad drying and minimal changes in the temperature and humidity of the incoming air. To significantly change the temperature and humidity of the incoming air with an interval timer, the pump typically needs to operate less than one minute and/or the pump needs to stay off roughly 20 minutes or more. In either case the pad will tend to produce less cooling of the incoming air because the entire pad will tend to be drier and the humidity of the incoming air will be lower. Interval timers are generally best suited for use when the goal is to limit the amount of cooling produced by a pad system (with younger birds, for example).

2) Just because the surface of the pad appears dry does not necessarily mean the pad is producing significantly less cooling and humidification of the incoming air than a pad with water flowing over it. As noted previously, reducing the thickness of a 6" pad by an inch will only reduce the cooling efficiency of pad by roughly 5%. Most of the cooling produced by a pad occurs deep within the pad, not at the surface. As a result, it is best to manage a pad based not on what it looks like, but rather by what it is actually doing.

3) Operating a pad using an interval timer from a bird cooling standpoint isn't necessarily problematic. In most instances, it doesn't dramatically change the temperature and/or humidity of the incoming air versus operating a pad based solely on air temperature. But, it is imporant to keep in mind that the water flowing over the surface of the pad not only serves to wet the pad but helps keep the surface of the pad clean. By limiting the amount of time water circulates over the pad surface, the rate at which minerals and dirt builds-up on a pad tends to increase.

4) The best method of controlling evaporative cooling systems is to base their operation on house air temperature. It is generally preferable to wait until house temperature reaches the low-to-mid-eighties, thereby giving a chance for the outside humidity to drop into the seventies or lower. This is because during hot weather outside temperature and relative humidity tend to cross-over at 80ºF and 80% humidity. Specifically, when the outside temperature is below 80ºF, the relative humidity tends to be over 80% (Figures 1 and 6). Using a pad system when house temperature is in the low eighties, or worse yet, seventies, will tend to produce little cooling of the incoming air and increase the humidity to near saturation regardless of how the system is being controlled. Though waiting until house temperature reaches the mid-eighties before using evaporative cooling pads will tend to result in slightly higher house temperatures, it is important to keep in mind that the humidity will be lower, which will make it easier for the birds to lose heat through respiration. Furthermore, with the increased heat removal associated with today's air speeds of 600 to 800 ft/min, birds are better able to cope with slightly higher house temperatures, especially when combined with a lower relative humidity. It is important to keep in mind that out goal during hot weather is not necessarily to cool the air more, but rather cooling to the birds more, which may require a slightly warmer, drier house.

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