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Poultry Housing Tips

Programing environmental controllers to minimize fuel wastage

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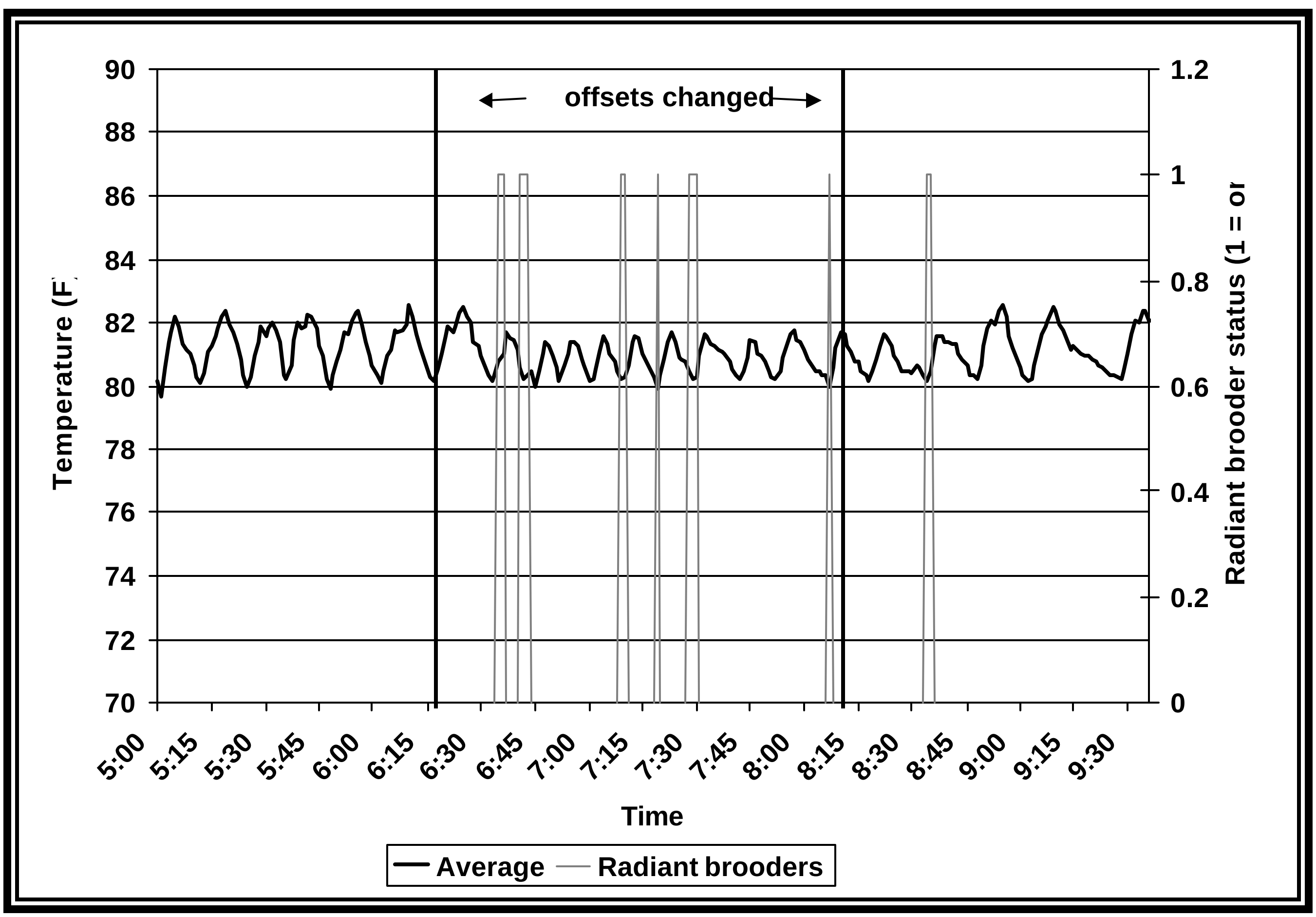

Figure 1. Average house air temperature and brooder status

In the past a broiler house "environmental control system" typically consisted of a few forced air furnaces for supplemental heat during brooding, four side wall 36" fans for minimum ventilation, a curtain machine to help control house temperature during mild weather, a row of 36" fans down the center of the house and a few dozen fogging nozzles to provide some limited heat stress relief during hot weather. The control of these devices was fairly unsophisticated and as a result growers either turned these devices on and off manually or, more commonly, used traditional mechanical thermostats.

Today a broiler house environmental control system has become significantly more involved. A modern broiler house may have up to ten tunnel ventilation fans which need to be individually controlled to maximize a producer's control over wind-chill as well as to minimize energy usage. In addition, the modern house will have 40 to 60 side wall inlet openings which must be coordinated with the exhaust fans so that the right inlet open is achieved when using different levels of inlet ventilation and then totally closed during tunnel ventilation. To insure a smooth transition between side wall inlet and tunnel ventilation, the number of fans operating must be coordinated with the tunnel curtain. Too few fans operating before switching to tunnel ventilation may result in large temperature difference between the two ends of the house. Operating too many fans can result in excessive static pressure and the possibility of harming dropped ceilings. Furthermore, if the producer has side wall fans, he needs to make sure that they are turned off when the house transitions into tunnel ventilation. The heating system may consist of brooders, as well as furnaces, which are used during different times of the grow out. The brooders may be controlled in zones so that the different heating requirements of the different areas of the house may be met. The heating system needs to be coordinated with the cooling system so the house does not try to heat and cool at the same time. The evaporative cooling system is no longer just on or off. To prevent over cooling younger birds, as well as to minimize run-off, fogging pads need to be staged so that as it gets hotter or as the birds get older more and more water is added to the pad. As a result, a producer may have three or more stages of evaporative cooling ranging from a single line of fogging nozzles wetting the pad at line pressure to three lines of nozzles running at 160 psi and another 60 nozzles inside the house producing additional cooling during extreme weather. Producers are quickly learning that with this much ventilation equipment proper environmental control can no longer be achieved through the use of traditional mechanical thermostats. As a result, electronic environmental controllers are quickly becoming common place.

Though electronic environmental controllers are virtually a must for a modern broiler house, how good of a job they do in controlling the environment within a poultry house depends entirely on how they are programmed. Electronic environmental controllers will only do what they are told. If they are programmed correctly, they can maintain nearly ideal conditions throughout the grow-out; but if programmed incorrectly, they can have adverse effects on both broiler performance and energy usage.

One common mistake with environmental controllers is trying to maintain too tight of a control over house temperature. This may not seem like a problem on the surface, after all birds require a consistent house temperature to obtain maximum performance. But, an interesting fact is that tighter temperature control can actually lead to greater variation in environmental conditions and actually increase operating costs.

Basically, all environmental controllers work off a set point. The set point is the temperature you would ideally like to have. When the air temperature in the house falls below the set point, the environmental controller will call for the heating system to come on. Conversely, if the temperature rises above the set point, the controller will call for cooling. The more the temperature rises above the set point the more devices (i.e., fans, tunnel curtain, evaporative cooling pads) the controller will bring on to try to reduce the temperature in the house. Obviously, when the temperature in the house goes just a degree or two above the set point you don't want all of your cooling to come on. Could you imagine what would happen if you had three week old birds in the dead of winter and the house temperature rose a degree above what you wanted and the environmental controller opened the tunnel curtain and turned on all the tunnel fans as well as the evaporative cooling system (you could easily program an environmental controller to do this). To prevent this from happening we must instruct the environmental controller to spread out the cooling by programming in small temperature differences or "offsets" between the cooling devices. The most important offsets are those we set for the heating system and the first "level" or "stage" of cooling. Typically this first level of cooling comprises the fans which are operating off of a five minute timer for minimum ventilation being turned on so they run constantly.

As a general rule, there should be a four degree difference between the temperature at which the heating system is turned on and the temperature at which the first stage of cooling is activated. For instance, let's say you had a house of 21 day old birds and the desired house temperature was 81F. Ideally, the furnaces/brooders would come on if the house temperature dropped to 79 F, two degrees below desired, and the timer fans would run constantly if the house reached 83 F, two degrees above the desired air temperature. As a result, during cold weather there may be as much as a four degree variation in house air temperature. Though it might be nice to have a tighter control over house air temperature, there are potential problems when tighter temperature control is attempted.

To show what can happen if you try to maintain a extremely tight control over air temperature, a brief experiment was conducted on a modern broiler house with an electronic environmental controller. The birds on the farm were 21 days old, and the controller was set to maintain a temperature of 81 F with a two degree cooling and a two degree heating offset (i.e., the heat came on if the house temperature dropped to 79 F and the minimum ventilation fans, one 48" fan and one 36" fan, came on to cool the house if the air temperature increased to 83 F). During the study the outside temperature ranged between 55 and 60 F, and minimum ventilation fans were set to operate 60 seconds out of five minutes. The controller was connected to a personal computer which enabled the producer to continuously monitor and record house temperatures as well as fan/heater status. At approximately 6:30 in the morning the heating and first stage of cooling offsets were decreased to one degree each so that the heat would come on if the house temperature dropped to 80 F and the minimum ventilation fans would come on at 82 F to cool the house. These settings were maintained for two hours and then the offsets were returned to their previous settings.

In Figure 1 the effect heating and cooling offsets had on average house air temperature can be seen. Before the heating and cooling offsets were changed the average house temperature varied a little over three degrees. After the cooling and heating offsets were reduced to one degree, the variation in average house air temperature was reduced to about two degrees and returned to a little over three degrees when the offsets were returned to their original settings. The cycling in house air temperature which occurred throughout the night and early morning was caused by the gradual buildup of bird heat followed by a gradual decrease in house air temperature when the minimum ventilation fans came on to cool the house. It is of importance to note that between the hours of midnight and 6:40 am the house was well insulated and tight enough that the birds produced enough heat that the radiant brooders in the house did not have to operate to maintain the proper house air temperature. When the cooling offset was decreased to one degree, the minimum ventilation fans came on quicker which reduced the length of the temperature cycle.

The graph of average house air temperature does not tell the whole story. In Figure 2 it can be seen that prior to changing the heating and cooling settings, there was approximately a five degree variation between the coolest and warmest sensors in the 500' house. This amount of variation is fairly typical and was caused by differences in bird densities throughout the house (birds were not quite spread out yet). In addition, a slightly leaky tunnel curtain (sensor 1) also contributed to the temperature variation. During the two hours that the heating and cooling offsets were decreased to one degree, the temperature difference between the sensors throughout the house was reduced to about three degrees because the heat came on in the cooler locations (near the tunnel curtain) to bring the house up to within one degree of the desired house. Though the house temperature was more uniform when the cooling and heating offsets were reduced the improvement was less than two degrees.

Though the short experiment showed that by reducing the heating and cooling offsets the temperature within the house became more uniform, there was a significant downside. From midnight to 6:40 am when outside temperatures were at their lowest, the radiant brooders were not needed to maintain the desired house air temperature. During the two hours during which the heating and cooling offsets were decreased, the brooders near the tunnel curtain as well as those in the center of the brooding end operated a total of 15 minutes. Though this increased total fuel usage by less than 10%, it is important to keep in mind the outside temperatures were very mild. During cold weather, if the one degree cooling and heating offsets were used, the heating and cooling system would be constantly fighting one another. Though the temperature would have been more uniform, the heating costs would have been considerably higher.

It is important to keep in mind that a significant amount of heat is produced by a house full of three week old birds. This can be seen in the fact that when the fans shut off the house temperature increased three degrees in about ten minutes even though the minimum ventilation fans were coming on one minute out of five. As a result, if after the minimum ventilation fans shut off and the house is left alone, the heat produced by the birds, in many cases, will bring the air

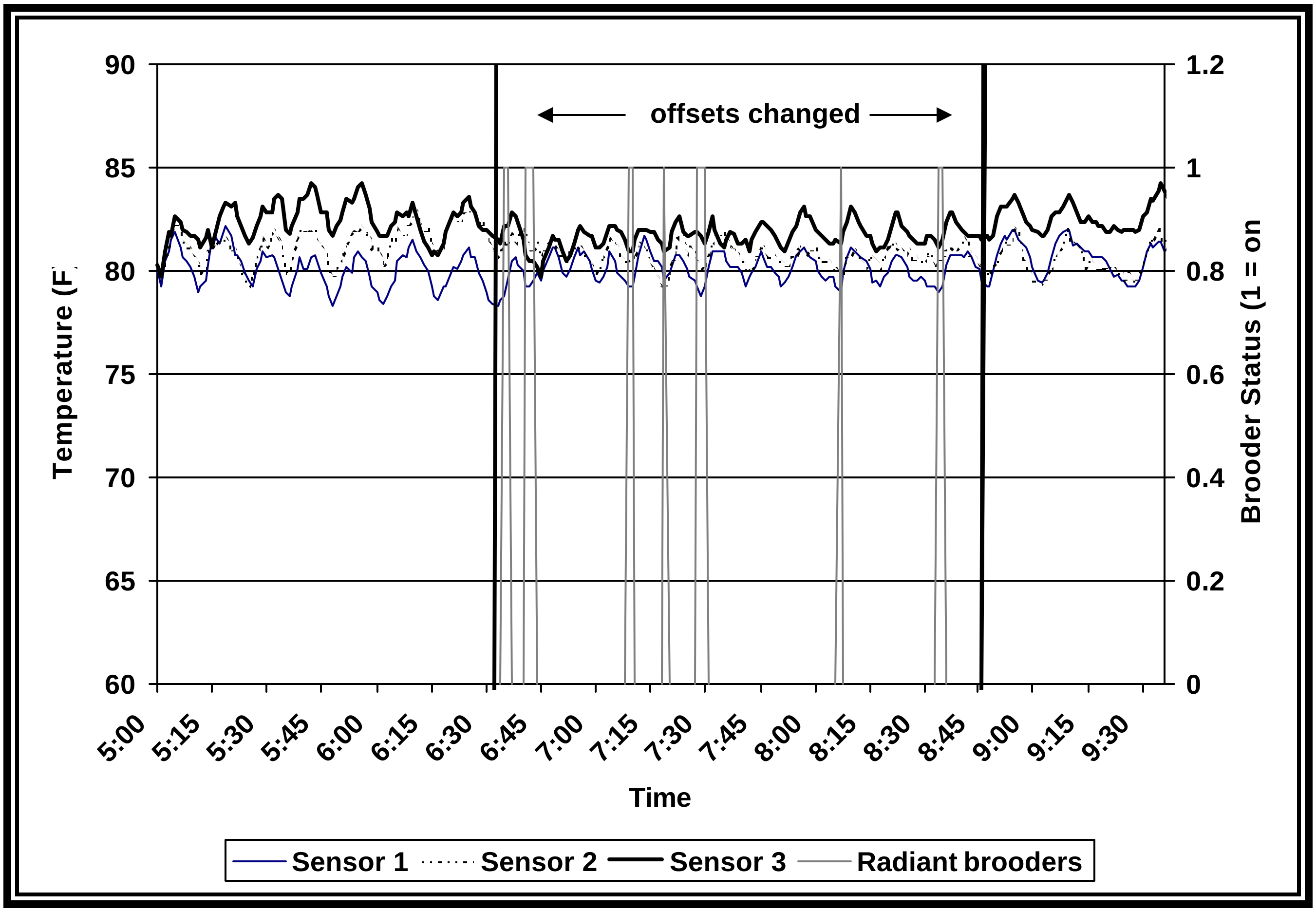

Figure 2. Air temperature at various house locations and radiant brooder status

temperature back up to the desired temperature. But, if the heat offset is set too low, the radiant brooders/furnaces will come on when they are really not needed. Furthermore, in many cases the combination of heat produced by the birds and heat produced by the brooders/furnaces results in an overshooting of the desired air temperature. This is because brooders do not stop producing heat immediately after they are shut off, as well as the fact it takes a couple of minutes for temperature sensors to respond to changes in house air temperature. When this overshooting occurs the minimum ventilation fans will come on to cool the house. So you can end up with the situation where the house is constantly cycling cooling...heating...cooling...heating...etc.

Special care must be taken with older birds to insure that the heating system does not fight with the minimum ventilation fans. As birds get older and minimum ventilation settings are increased and the likelihood of the minimum ventilation fans turning on the heating system each time they run increases. For instance, on older birds the minimum ventilation fans may need to run two or possibly three minutes out of five to insure proper air quality. When the fans run this much during cold weather, the house temperature may fall three or four degrees. Now, as we saw with the three week old birds, if the house is left alone, the heat produced by the birds will quickly bring the air temperature in the house back up to the desired range. But, if the heating offset is maintained at two degrees the heat will come on before this can happen. This is why as birds get older the heating offset should be increased. Starting at three weeks of age the heating offset should be increased approximately one degree per week. As a result, the heating offset should be three degrees the third week, four degrees the forth, etc. Since the birds are fairly well feathered by this age even a drop in house temperature of four degrees or more below the desired for short periods of time should not present a problem.

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