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Poultry Housing Tips

Thermometers and Temperature Sensors Do Not Measure Effective Air Temperature

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You have market age birds on a hot summer day. All your fans are running as well as your evaporative cooling pads. You check your house temperature and it is running 84°F.The birds appear comfortable. Seeing all those fans running you start to think about this month's upcoming power bill. It is probably going to be a big one. You wonder if you could shut off a couple of fans and save some power without sacrificing house temperature. You try it. Surprisingly enough, the house temperature only goes up about one degree. This is great! You have just reduced your fan operating cost by 20% or so and really haven't changed house temperature. After all what is the difference between 84°F and 85°F?

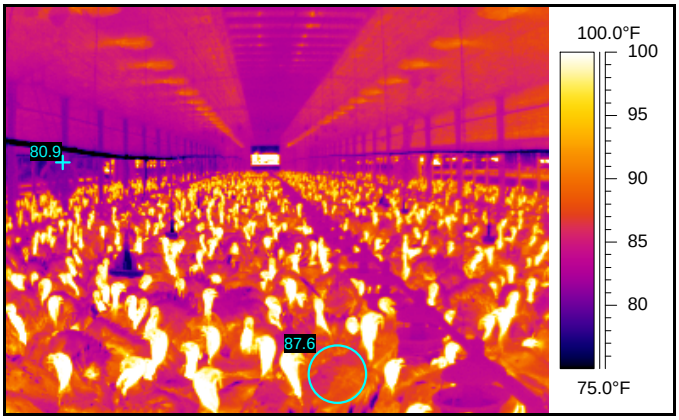

Figure 1. Naturally-ventilated Turkey Barn.

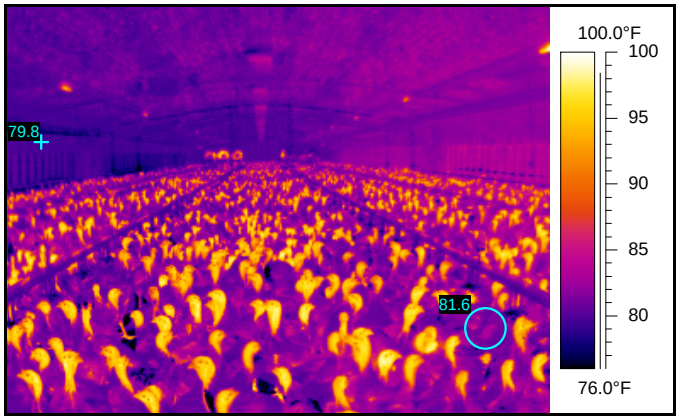

Figure 2. Tunnel-ventilated Broiler House.

The fact is that though actual house temperature didn't change very much, you did significantly increase "effective" house temperature. Effective temperature is essentially the temperature a bird physiologically "feels" it is. Effective temperature is determined not only by actual house temperature, but relative humidity and wind speed as well. For instance, since a bird loses a significant amount of heat through the evaporation of water off its respiratory system, its ability to cool itself during hot weather is affected by humidity. The lower the humidity, the more water that can evaporate off a bird's respiratory system. The greater the evaporation, the greater the heat loss from the bird, and the cooler it "feels." Therefore, 84°F and 20% Rh "feels," and is in effect, much cooler to a bird than 84°F and 85% Rh. Likewise, air speed over a bird affects heat removal from a bird and therefore affects effective temperature. For instance, at 84°F a wind speed of 500 ft/min moving over a bird removes much more heat than does a wind speed of 100 ft/min and therefore the effective temperature would be much lower at 500 ft/min than at 100 ft/min. This a very important fact to keep in mind when it comes to bird management. Whether it is 20% Rh, or 80 % Rh or whether the air speed is 100 ft/min or 500 ft/min, a thermometer or temperature sensor in a house would indicate the same temperature, but in fact the effective temperature would be very different.

Thermal images taken in two side-by-side turkey houses (one naturally ventilated and one tunnel-ventilated) on a 79°F day provide a good illustration of how actual air temperature can be very different from effective air temperature. The

air temperature was 81°F in the naturally ventilated house and 80°F in the tunnel-ventilated house. So according to the thermometers in each house, there was essentially no difference in air temperature between the two houses. But, since there was a difference in air speed, less than 100 ft/min in the naturally ventilated house and 600 ft/min in the tunnel-ventilated house, there was a significant difference in effective temperature. This fact is clear when comparing Figure 1 to Figure 2. The surface temperature of the birds in the naturally ventilated house was seven degrees above the ambient air temperature, indicating that the heat was not being adequately "pulled" from the birds. The surface temperature of the birds in the tunnel-ventilated house was only a degree or two above ambient air temperature, indicating the heat was being pulled from the birds as quickly as it was being produced, resulting in cooler birds and a lower effective air temperature. Though a thermal camera does a nice job of illustrating a difference in effective air temperature, it was also clear from the fact that the birds were panting in the naturally ventilated house and not in the tunnel-ventilated house.

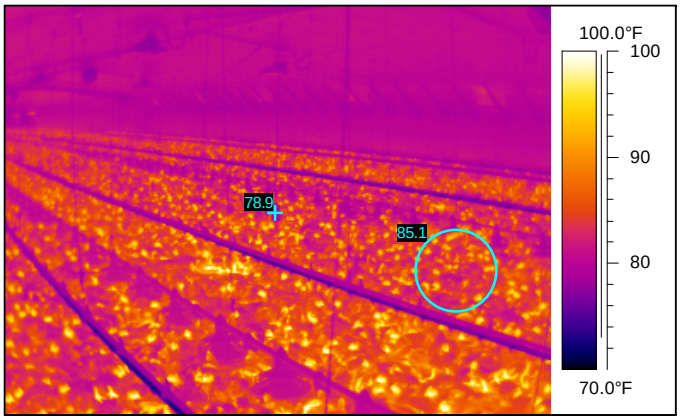

Figure 3. Tunnel-ventilated Broiler House (550 ft/min).

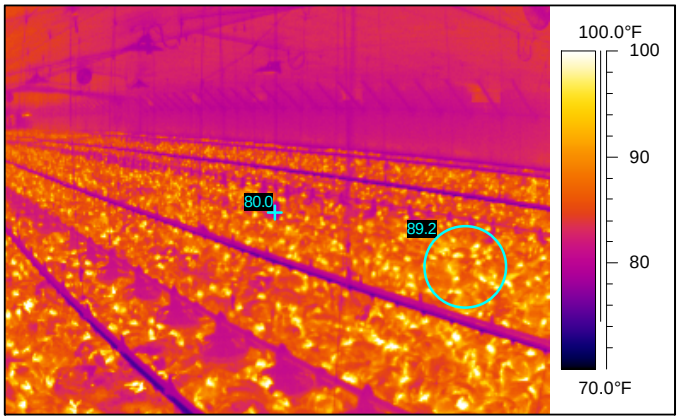

Figure 4. Tunnel-ventilated Broiler House (350 ft/min).

The difference between effective and actual air temperature is also illustrated in the above thermal images taken in a tunnel-ventilated broiler house with market age birds. In Figure 3 all the tunnel fans are operating, producing an air speed of 550 ft/min. The air temperature indicated by the sensor located in the center of the house was approximately 79°F. Average bird surface temperature (including head temperature) was approximately 85°F. Three of the house's ten fans were turned off which decreased the air speed to approximately 350 ft/min (Figure 4). Though the temperature in the center of the house only increased one degree to 80°F, bird surface temperature increased over four degrees to nearly 90°F and the birds were noticeably hotter.

Another point to keep in mind is that on a hot summer day in a tunnel-ventilated house with evaporative cooling pads, the house temperature will tend to be in the low to mid eighties and the relative humidity to run 80% or higher. The high relative humidity is due to the fact that for every one degree you decrease house temperature using evaporative cooling, relative humidity will increase approximately 2.5%. So on one hand, with evaporative cooling you are increasing bird cooling with a lower house temperature, but on the other you are reducing bird cooling because you are raising the relative humidity of the air in the house, reducing the heat loss through respiration. The fact is that if you don't have any air movement over the birds, an evaporative cooling system can end up harming the birds more than helping them. What enables us to use evaporative cooling systems effectively in the relatively humid climates where birds are often grown is the high amount of air movement over the birds produced in the typical tunnel-ventilated house. The greater the air speed in a tunnel house, the more heat we are pulling off the birds through air movement. The less the bird has to cool itself through panting, the less problematic a high relative humidity is to a bird during hot weather.

When you turn off a couple of fans in your tunnel houses with market age birds in the hope of reducing operating costs, though house temperature doesn't change, the decrease in air speed coupled with the high relative humidity produced by the house's evaporative system increases the effective temperature greatly. This results in hotter birds and reduced bird performance. Keep in mind that thermostats and temperature sensors measure actual air temperature, not effective air temperature.

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