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Poultry Housing Tips

1/15 h.p. Circulation Fans

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Figure 1. 1/15 h.p. circulation fan

Circulation fans have proven to be beneficial to broiler producers in a variety of ways. Studies have shown that by gently moving hot dry air off the ceiling down toward the floor, floor temperatures can be increased, litter moisture decreased and fuel usage reduced between 10% and 30%.

There are a number of different types of circulation fans used by broiler producers today ranging from 56" paddle fans to 18" 1/3 h.p axial fans. Though these fans have proven to do an excellent job in reducing temperature stratification, they do require proper management to insure that they do not produce excessive air movement over chicks. For instance, paddle fans often need to be installed so that they blow the air upward and placed on a variable speed controller. One-third horsepower 18" or 24" circulation fans should be placed on an interval timer so that they quickly mix the air next to the ceiling with that near the floor then shut down. And 36" box fans, though useful when directed upward in open ceiling houses and placed on an interval timer, are next to impossible to use in a dropped ceiling house without chilling chicks and blowing out brooder pilot lights.

There is now another option when it comes to circulation fans for broiler houses that has a few advantages over many circulation fans currently used. The 18" "basket" fan with an 1/15 h.p motor has been in use by the greenhouse industry for over 10 years to gently mix the air in a green house without producing excessive air movement over the plants. The

fact that the fan motor draws less than an amp of electricity, is of simple construction (direct drive motor with prop and protective wire basket), and relatively low cost ($130 - 145) has made the fan very popular among green house owners.

To evaluate the effectiveness of 1/15 hp circulation fans to reduce temperature stratification in broiler houses, six fans were installed in a broiler house on a farm in north Georgia. Three fans were placed on both the brooding and nonbrooding ends of a 40' X 500' dropped ceiling house. Starting at the end walls, fans were installed 70' on center which left approximately 40' between the last fan on each end of the house and the brooding curtain. The fans were hung from chains within a couple inches of the ceiling and directed to blow air parallel to the floor towards the end walls of the house (Figure 2). The fans were equipped with a variable speed controller to enable the producer to adjust the fan speed if he felt they were producing too much air movement at floor level.

Figure 2. Ceiling circulation fans (arrow points out second circulation fan).

Figure 3. Air slowly flowing in opposite direction along the floor (arrows denote direction of air flow at the floor and the ceiling)

Temperature sensors were placed approximately 12" above the floor in the vicinity of the three circulation fans on the brooding end of the house. Combination temperature/humidity sensors were placed at the floor and the ceiling in the center of the brooding area. The houses were equipped with an environmental controller so that brooder run time could be monitored. Conditions and brooder run time were compared to an identical house without circulation fans on the same farm during the winter and early spring of 2003.

Through smoke testing it was found that the 70' spacing enabled the circulation fans to work together as a unit (Figure 2). The air from one circulation fan just made it to the next fan which then moved it to the next fan and so on. Air flowed very slowly in the opposite direction along the floor resulting in an excellent mixing of the air throughout the house (Figure 3). Even though the radiant brooders were only about four feet from the ceiling the air movement produced by the circulation fans remained so close to the ceiling that brooder pilot lights were not disturbed (Figure 3). Air speed was checked at floor level and it was found to be minimal (less than 50 ft/min). Because there was so little air movement at floor level it was decided to run the fans at full speed, continuously over the course of the flock. At no time were the birds found to react adversely to the presence of the circulation fans.

Temperature stratification in the house without circulation fans varied significantly depending primarily on how much the heating system was operating. At night during cold weather with young chicks present, temperature stratification was as high as 20°F due to the radiant brooders operating nearly constantly. During the early spring when less heat was needed to keep the house warm, temperature stratification ranged from two degrees during the day to ten degrees at night (Figure 4). Conversely, in the house with circulation fans, air temperature at the ceiling was at most a couple of degrees warmer than that at floor level regardless of the amount of time the brooders operated (Figure 5).

Though air temperature at floor level was tightly controlled in both houses through the use of modern environmental

controllers, it was found that the circulation fans did a better job of moving air down to the floor leading to slightly higher air temperatures near the floor. For example on the night of March 6th when the birds were just a few days old the desired house temperature was 91.25°F. The heat was set to come on at 89.25°F and shut off at 90°F. In the house without circulation the air temperature in the house ranged between approximately 89 and 90°F (Figure 6). But in the house with circulation fans the house temperature continued to rise after the brooders shut off, raising the house temperature to the set temperature (Figure 7). Though this produced a slightly greater variation in house air temperature, the circulation fans on average increased air temperature.

Another benefit discovered during the study was that since the circulation fans did a better job of moving the heat produced by the brooders, the brooders tended to cycle on and off less. During the two hours illustrated in Figures 6 and 7, the brooders in the house with circulation fans cycled on and off approximately 20% fewer times than the house without circulation fans. The reduction in cycling not only reduced wear and tear on the radiant brooders, but was likely responsible for a portion of the fuel savings noted in the house with circulation fans.

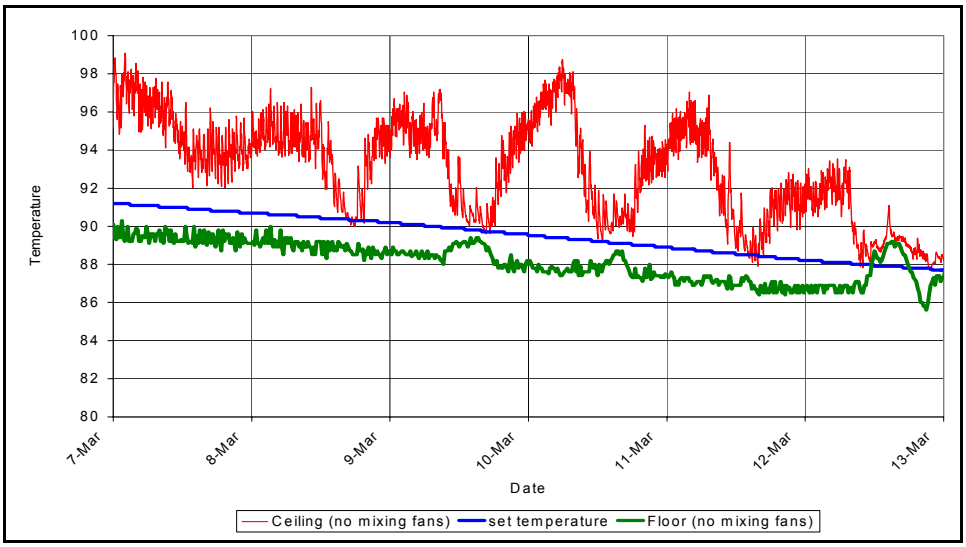

Figure 4. Floor and ceiling air temperatures in test house without circulation fans.

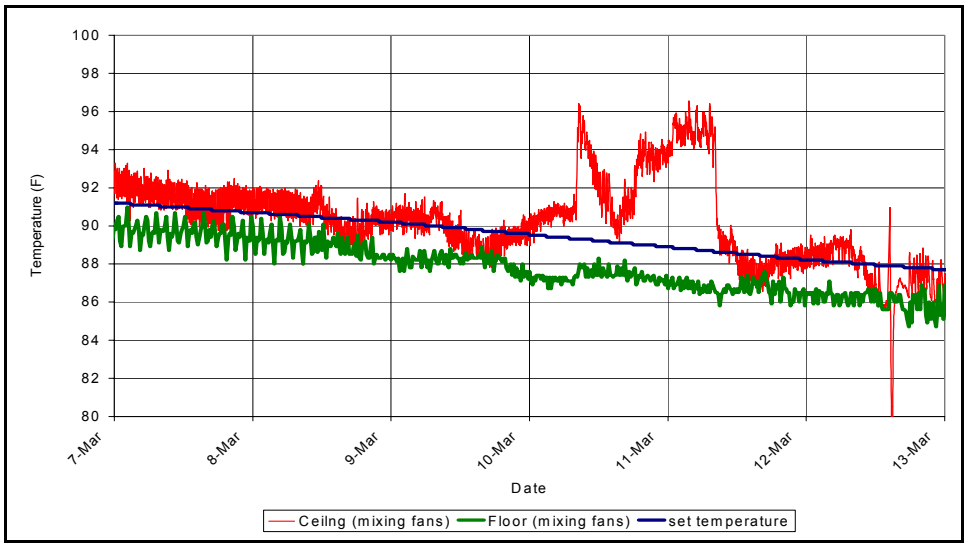

Figure 5. Floor and ceiling air temperatures in test house with circulation fans. Circulation fans were turned off March 11 for 24 hours, notice the increase in stratification.

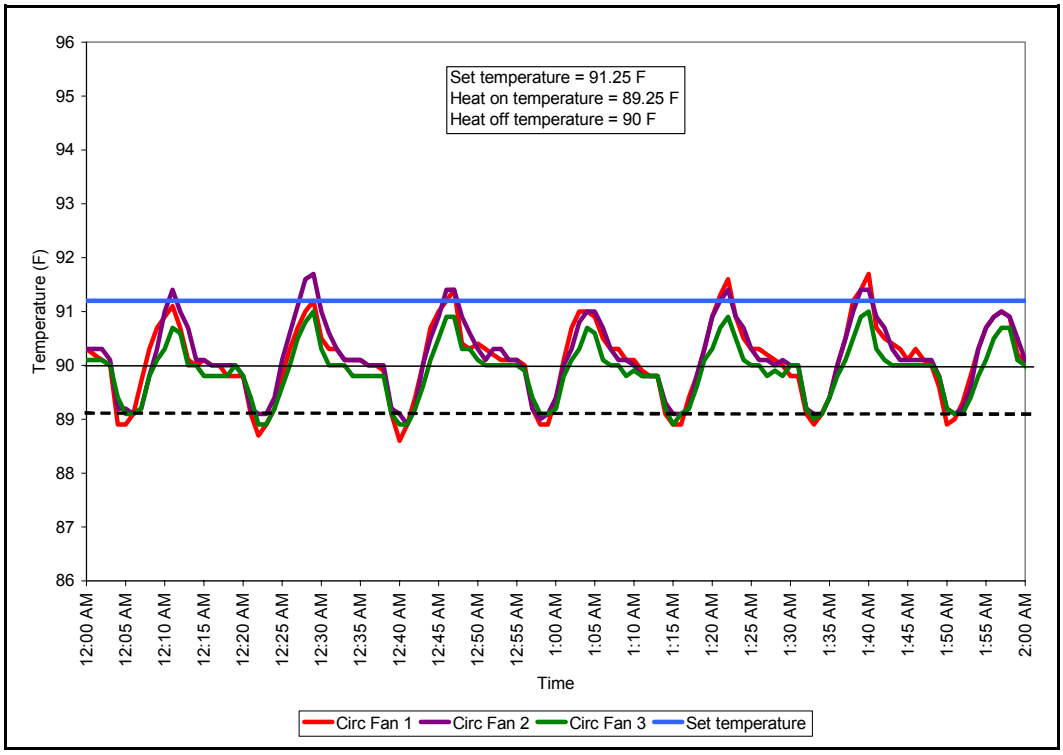

Figure 6. Floor air temperatures in house with circulation fans (measurements were taken in the vicinity of the mixing fans at floor level).

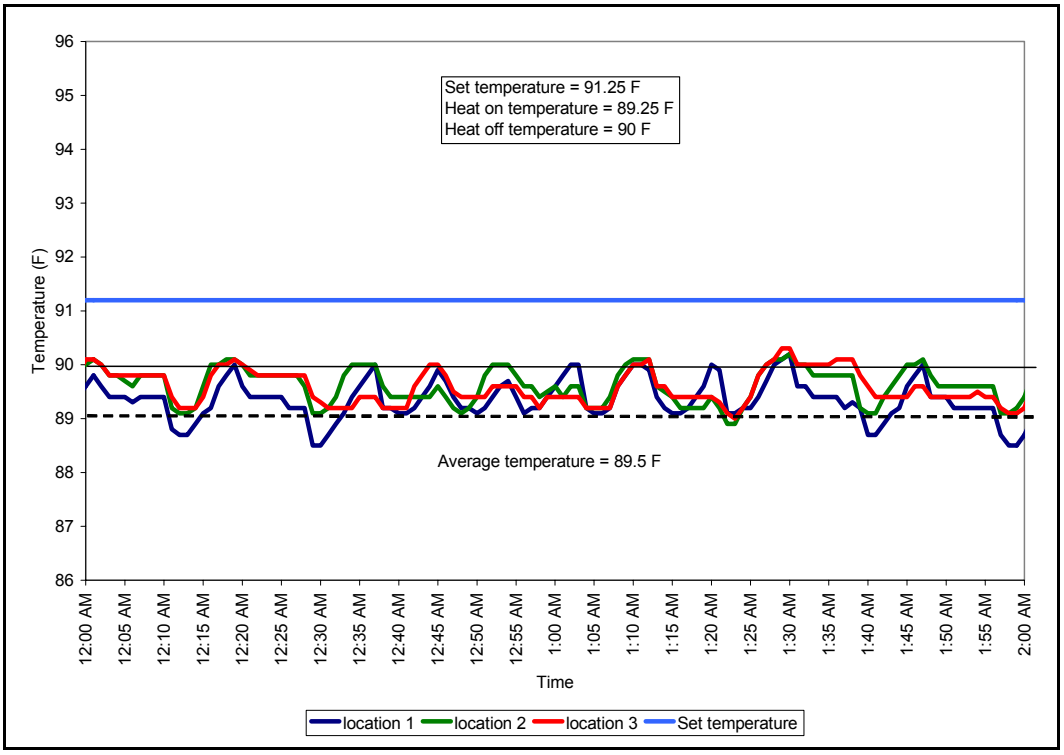

Figure 7. Floor air temperatures in house without circulation fans (same positions as house with circulation fans).

Fuel usage, as monitored by brooder runtime, was as much as 20% less in the house with circulation fans. The greatest difference was on the coldest days when there was plenty of extra hot air at the ceiling to move to floor level. As you might suspect, on milder days when the brooders were operating very little, there was no difference in brooder runtime between the two houses. Overall the circulation fans were found to reduce fuel usage by approximately 10 to 15%.

During the study it was noticed that the air temperature near the brood curtain in both houses was a little cold due to air leaking around the brooding curtain. The colder temperatures lead to more caking in the brood curtain area than what was seen in the rest of the house. To remedy this situation in the house with circulation fans, the fan nearest the brooding curtain was turned 180 degrees to blow air at the brooding curtain. This simple change not only made the area near the brooding curtain warmer but also helped to keep the litter drier.

Another benefit of circulation fans noted during the study was that brooder run time varied little between the four zones in the brooding end of the house (Figure 8). In tunnel-ventilated houses the brooders nearest the tunnel curtain and brooding curtain tend to run the most while those in the center of the house run the least (Figure 8). This is due to the fact that the ends of the brooding area are typically looser and/or more poorly insulated than the remainder of the house. Since two circulation fans were oriented to move air toward the tunnel curtain and one toward the brood curtain, this tended to push excess heat from the center of the brooding area to the ends of the brooding area where it was needed.

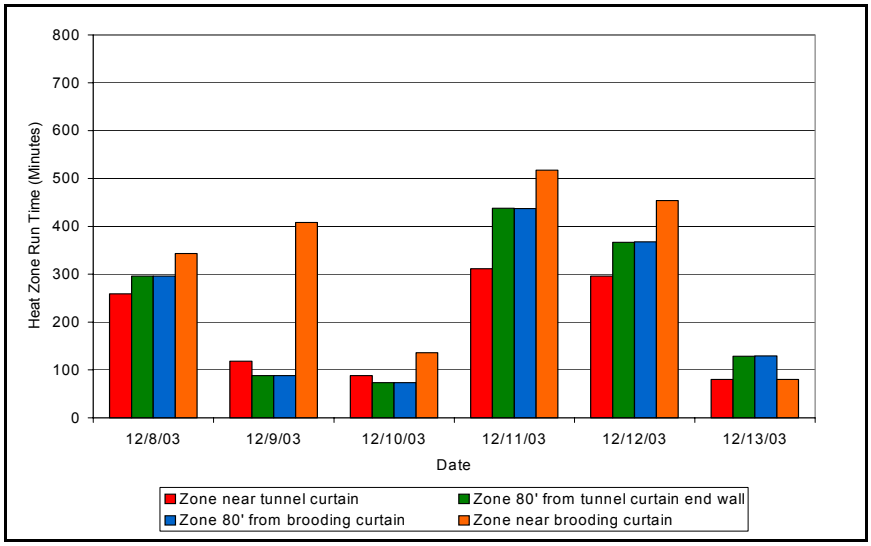

Figure 8. Heat zone runtime in house with circulation fans

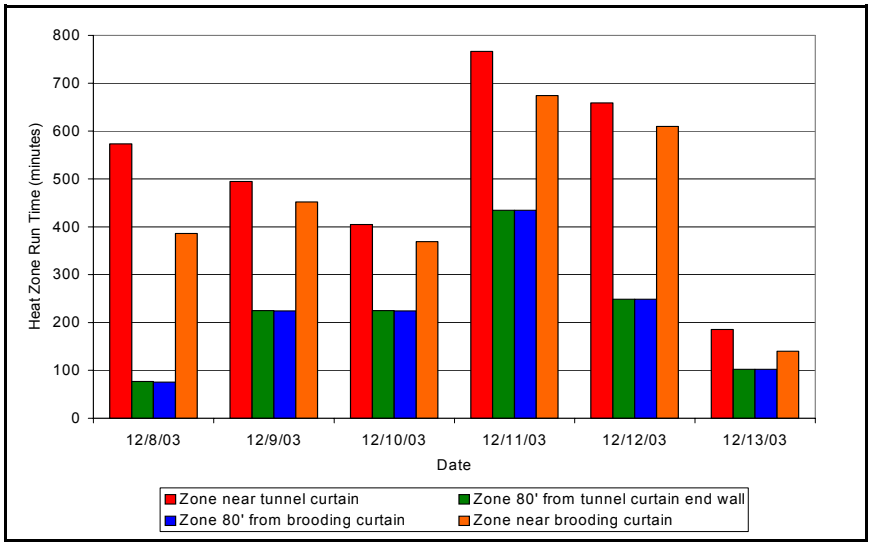

Figure 9. Heat zone runtime in house without circulation fans

In addition to keeping the air at the floor warmer the relative humidity at floor level was significantly lower in the house with circulation fans. As seen in Figure 6 the relative humidity in the house without circulation fans was on average 85% at floor level while at the ceiling it was only 75%. In the house with circulation fans, during the same time, the relative humidity at the floor and the ceiling was nearly identical at 75%.

It is important to realize that even a relative humidity of 75% is too high, and as a result the house has significant caking of the litter. But, as you might suspect it was not as bad as in the house where the relative humidity at floor level was 75%. Ideally, the relative humidity should be closer to 60%. This would have resulted in drier floors in both houses as well as lower ammonia levels.

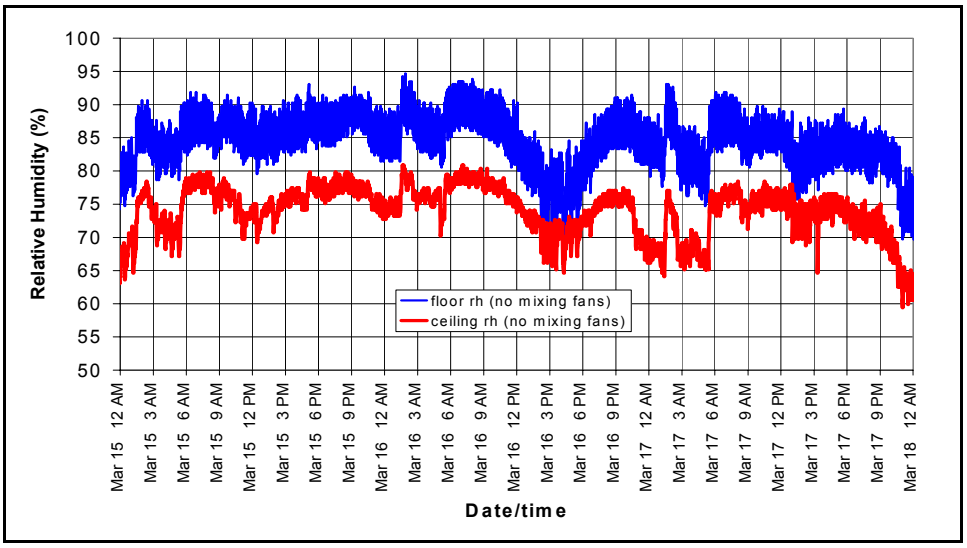

Figure 8. Relative humidity of the air at floor and ceiling level in house without circulation fans.

During the second flock it was noticed that the air temperature near the brood curtain was a little cold due to air leaking around the brooding curtain. The colder temperatures lead to more caking in the brooding curtain area then what was seen in the rest of the house. To remedy this situation the circulation fan nearest the brooding curtain was turned 180 degrees to blow air at the brooding curtain. This simple change not only made the area near the brooding curtain warmer, but also helped to keep the litter drier.

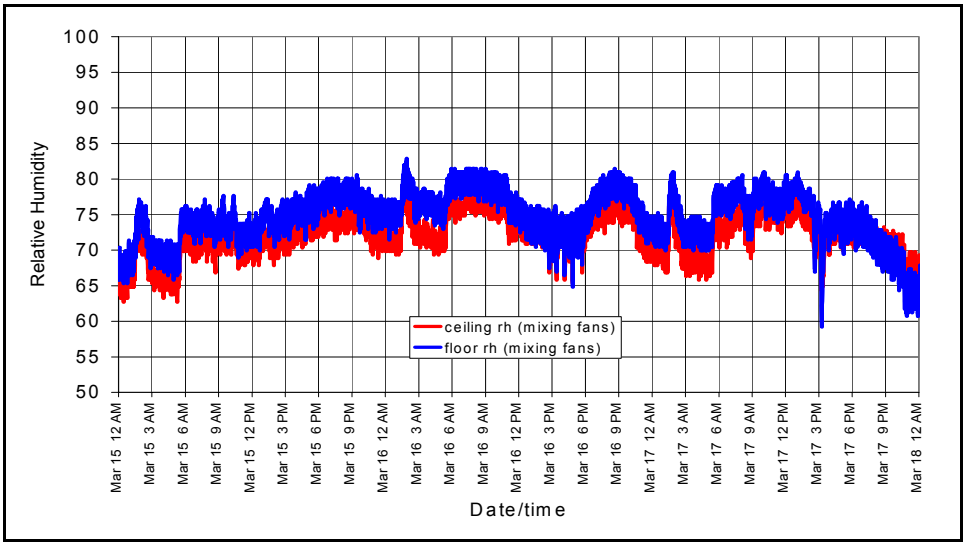

Figure 9. Relative humidity of the air near the ceiling and floor in house with circulation fans.

The circulation fans in the nonbrooding end of the house performed similarly to those on the brooding end, reducing temperature stratification and moving warm air to the tunnel fan end wall – traditionally a cool spot in most broiler houses. The combination of the one circulation fan in the brooding area and the three circulation fans in the nonbrooding area blowing air toward the tunnel fan end wall helped to move the heat to the nonbrooding end a little quicker when the birds were turned out.

The 18" 1/15 h.p circulation fans proved to be a very effective tool in both reducing temperature differences between the ceiling and floor, as well as from one end of the brooding area to the other. The small power requirements and size of the fan make it easy to install and wire, making it a good option for both new and older broiler houses.

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