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Poultry Housing Tips

European Air Inlets...A First Look

Volume 16 Number 11 **October, 2004**

Figure 1. European side wall inlet

When it comes to the modern broiler house there have been significant advancements in virtually all the components of the environmental control system. Tunnel fans have progressed from simple 48" box fans to state of the art 50"+ fans with discharge cones, interior shutters shaped like air foils, and high efficiency motors. The combination of these changes has increased the overall energy efficiency of tunnel fans by as much as 50% over the last ten years. Poultry house evaporative cooling systems have evolved from interior low pressure fogging systems, to fogging pads, to high efficiency six-inch pad systems that maximize cooling of incoming air while keeping house moisture and management time to a minimum. Heating systems have progressed from individually controlled pancake brooders, to zone-controlled radiant brooders, and in some instances, radiant tube brooders. Controlling all this equipment, once done with simple mechanical thermostats, is now done with modern microprocessor-based environmental controllers that precisely control and coordinate all heating and ventilation system components to give the broiler producer a high level of control over environmental conditions within their houses. With all these changes, there is one environmental system component that has changed little over the last 15 years: the galvanized side wall inlet.

Though the traditional galvanized inlet has done a decent job of controlling air quality and temperature, it has some weaknesses that are becoming more apparent as houses become wider. One of the biggest weaknesses of the galvanized side wall inlets is their size. Traditionally, inlets were made to fit in a hole approximately seven inches tall. One of the reasons for this is that a producer could simply cut out a section of a wall made of 2" X 8"'s and insert an inlet. Though with many houses today the ability to fit an inlet into a hole made in a 2" X 8" is no longer an issue, this inlet size has become a standard (Figure 2).

Figure 2. Standard galvanized side wall inlet

The amount of air flow we can draw through each inlet changes with inlet opening and pressure. For instance, if a standard 44" long galvanized inlet is opened two inches, roughly 600 cfm will enter through the inlet at a static pressure of 0.08". If the inlet opening is increased to four inches, air flow through the inlet will increase to approximately 1,200 cfm and when fully opened 1,800 cfm. This means that if a house has 60, 44" galvanized inlets, approximately 36,000 cfm of exhaust fan capacity would be required to get all the inlets to open two inches at a 0.08" static pressure (assuming the house is perfectly tight). The fan capacity required to open the inlets two inches is important because of the fact that in most houses during cold weather it typically takes about a two-inch opening and a static pressure of at least 0.08" to get the air to the center of the house. Now considering even a very tight house has around 10,000 cfm of leakage, to get all the inlets in the house to open two inches, would more realistically require 46,000 cfm of exhaust fan air moving capacity (approximately five 36" fans).

As the number of inlets installed in a house increases, the fan capacity required to open all the inlets a couple of inches at a static pressure of 0.08" also increases. For instance, if a house has 80 inlets, due to the fact that the house is wider or a producer wants to operate more tunnel fans through their inlets, it now requires nearly 70,000 cfm of exhaust fan capacity to get all the inlets in the house to open a couple of inches. The problem with using 50,000 to 70,000 cfm of exhaust fan capacity for minimum ventilation is that during cold weather significant variations in house air temperature will occur. To minimize temperature variations as well as fuel costs, it is always best to operate as few minimum ventilation fans as possible to get the right combination of inlet opening and static pressure. For example, you will tend to have more consistent house temperatures if you operate two 36" fans two minutes out of five, than four fans one minute out of five. Figures 3 and 4 illustrate this fact as well as the importance of a short timer cycle. In one house the producer was using three 48" fans running three minutes out of ten, while in another there was three 36" operating two minutes out of five. Though it is true the three 36" fans operating two minutes out of five is around 30% less air than the three 48" fans operating three out of ten minutes, the fact remains that there was 80% less variation in house temperature in the house using the three 36" fans for minimum ventilation.

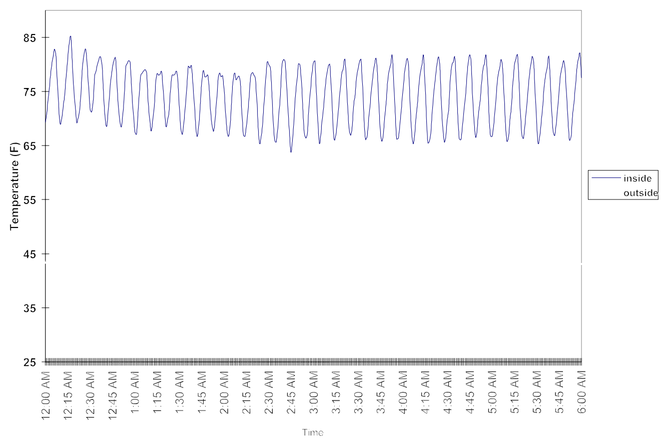

Figure 3. Three 48" fans 3 minutes out of 10.

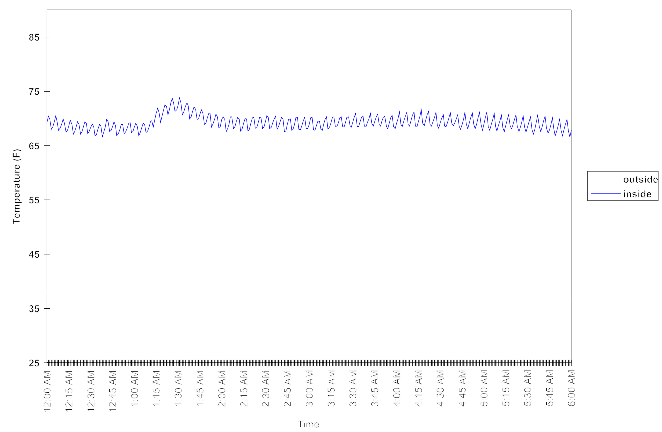

Figure 4. Three 36" fans 2 minutes out of 5.

To solve the problems with having an excessive number of inlets for minimum ventilation, producers have traditionally latched inlets closed during cold weather. By latching inlets closed, producers have found that it takes fewer fans to get the optimal combination of inlet opening and static pressure, thus maximizing heating of the incoming air.

Though effective, there are problems with latching inlets. During the spring and fall there can be significant differences in the number of fans required between daytime and nighttime. At night, a producer may only need to operate a few timer fans to maintain proper air quality, while during the day up to half the tunnel fans may be required to keep their birds cool. The problem of course is that in order to get the optimal combination of inlet opening and static pressure at night when it is cold, half of the inlets may need to be latched closed which means they will have to be unlatched during the day to provide sufficient opening when a large number of fans may be required to keep the birds cool.

Figure 5. 11" X 44" galvanized side wall inlet

The best solution to the problem of having too many inlets is to simply install fewer, taller inlets. For instance, instead of installing 80 six-inch-tall inlets in a 50' X 500' house, a producer can install 40, twelve-inch-tall inlets (Figure 5). The larger inlets have an increased operating range so the need for latching inlets closed is virtually eliminated (except for those on the nonbrooding end during brooding). Furthermore, fewer inlets mean fewer inlets to purchase, install, manage, and maintain.

But there is a problem with installing taller inlets. As the height of a galvanized inlet is increased, the greater the percentage of the air that enters through the side of the inlet as compared to the top of the inlet. When a standard six inch tall inlet is opened two inches, approximately 10% of the air will enter through the sides of the inlet. With a 12" tall inlet this increases to approximately 25! This means 25% of the air is not moving along the ceiling of the house to the center of the house and is dumping along the side wall with little preheating taking place, thus leading to an increased possibility of cool side walls and wet litter! (Figures 6,7,8)

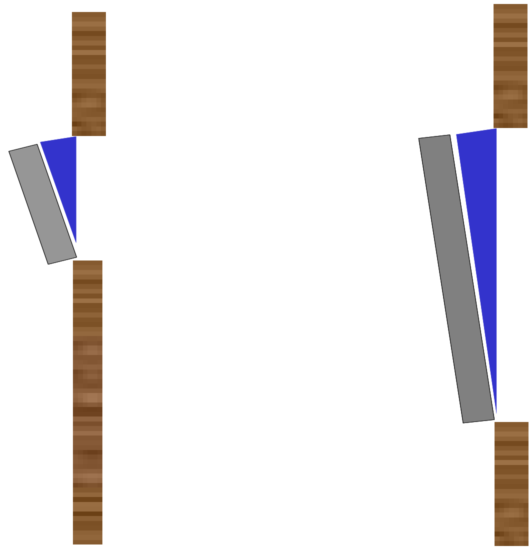

Figure 6. Side view of short and tall galvanized side wall inlets

Figure 7. Six inch tall inlet opened 2"

Figure 8. 12" tall inlet opened two inches.

A solution to this problem is recessed or European-style inlets.   European-style inlets are mounted in the side walls, not on them (Figure 9). The arc-shaped inlet door sits at an angle inside a heavy plastic housing with the top of the door closing against the inside frame surface while the bottom of the door sits near the outside wall. The angled door tends to throw the air up to the ceiling at a 45-degree angle instead of straight up the side wall (Figure 10). When the inlet is nearly fully opened, the bottom of the door lifts up to the point where the door is parallel to the floor. The arc shape then tends to direct the incoming air toward the floor (Figure 11).

Figure 9. 11" X 44" Optiflex$_{TM}$ inlet

Figure 10. Optiflex inlet opened one inch.

Figure 11. Optiflex inlet full opened.

Since the inlet door sits inside the deep frame, all the air enters through the top of the inlet. Smoke testing of the inlet showed not only that no air blows out the side of the inlet, but actually air near the side wall is drawn into the inlet, leading to significant warmer side walls (Figures 12, 13).

Figure 12. Air blowing outside of galvanized inlet.

Figure 13. Air flowing into side of Optiflex inlet.

There are a number of other advantages of the European-style inlets over the traditional galvanized inlets. First, the inlets are made exclusively of heavy insulated plastic. This dramatically reduces condensation and eliminates rusting problems. Furthermore, since there is no exposed insulation, the likelihood of rodent and beetle damage is significantly reduced. The fact is that many of the European-style inlets are made so well, that they should easily last the life of the building.

Figure 14. Light hood (air enters both the top and bottom of the hood)

To evaluate the possible benefits of the European-style inlet, 38 Optiflex$_{TM}$ inlets were installed in a 54' X 500' broiler house in West Georgia. The inlets were installed evenly down both side walls within three inches of the ceiling. Latches were installed on the inlets on the nonbrooding end for use during half-house brooding. Inlet opening was controlled through the use of a conventional inlet machine/environmental controller. A simple light deflector was installed outside each inlet to minimize the amount of light that could enter through the inlets (Figure 14).

Testing confirmed the fact that the producer could easily operate six of the house's twelve 48" cone fans through the 38 Optiflex$_{TM}$ inlets (3,200 cfm per inlet). Had traditional inlets been installed more than 80 inlets would have been required to accomplish the same goal. The 38 inlets were found to do a very good job of distributing fresh air in the 54' wide house during both cold and mild weather.

For comparison purposes, one of the Optiflex$_{TM}$ inlets was replaced with a similarly sized traditional galvanized inlet. Smoke and air velocity measurements showed the Optiflex$_{TM}$ inlets did a better job of moving air to the center of the 54' wide house. Air velocity measurements taken 20' from the side wall near the ceiling were 50% higher with the Optiflex$_{TM}$ inlet than with the galvanized inlet. Infrared images of the side wall and the ceiling illustrated the fact that significantly less air was being dumped on the side wall with Optiflex$_{TM}$ inlets than with the galvanized inlet (Figures 15,16). Smoke tests and dust patterns also showed more air was making to center of the house (Figures 17,18).

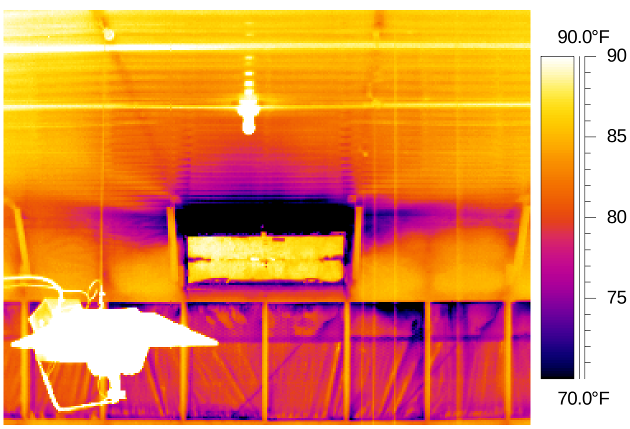

Figure 15. Thermal image of tall galvanized inlet.

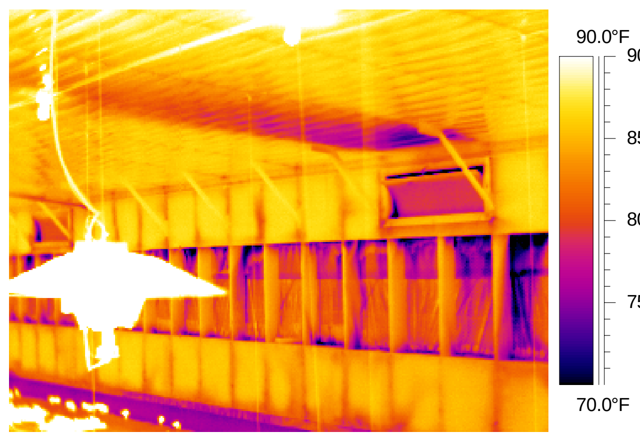

Figure 16. Thermal image of Optiflex$_{TM}$ inlet.

Figure 17. Dust patterns near tall galvanized inlet.

Figure 18. Dust patterns near Optiflex$_{TM}$ inlet.

Over the past year the Optiflex$_{TM}$ inlets have been problem free. The combination of the very light doors, lack of hinges, and the use of steel rod to open and close the inlets has led to essentially no need for inlet adjustments over the first year of operation. The higher insulation value of the Optiflex$_{TM}$ doors had lead to noticeably less condensation than on the galvanized metal door.

The only downside of the European-style doors is initial cost. Prices of these doors typically range between $50 and $100. Though this may seem high at first, it is important to keep in mind that around half as many inlets and light hoods have to be purchased and installed. Furthermore, the quality of most of these inlets should mean that the inlets will last twice as long as the traditional galvanized metal inlet. Last but not least, improved inlet performance should over time lead to improved environmental conditions and possibly bird performance. The good news is that there are a number of manufacturers working on European-style inlets, which should lead to lower prices in the long run.

The evaluation of the Optiflex$_{TM}$ inlets on the test farm will continue next year. A study of the Optiflex$_{TM}$ inlets has also been planed for a 60' wide house in Delaware this fall. Studies of inlets of similar design are also in the works. It is important to keep in mind that the success of wider houses in the future will depend on the quality of the inlet installed. Though the traditional inlets have done a good job in the past, houses in the future will need inlets that better match the overall quality of the other ventilation system components in order to maximize environmental control and energy conservation.

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