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Attic Inlet Technology

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The cost of fuel for poultry house heating has increased so dramatically in the past five years growers are exploring every imaginable alternative to reduce energy costs. Good poultry house energy management starts with a tight, well sealed and insulated poultry house and a properly managed ventilation system. Beyond these measures, reducing fuel costs must rely on utilization of an alternate heat source. A possible alternate heat source being examined by Auburn University Extension Engineers, Poultry Scientists and Economists is recovery of solar heat from the attic of poultry houses. The large roof areas of dropped ceiling poultry houses make very good solar collectors, so there is a large amount of heat readily available in the attic of a poultry house.

Using free solar heat from the attic can not only help reduce fuel costs for brooding and growing but also help lower relative humidity and reduce litter moisture. Reducing fuel costs may be the major advantage of using attic inlets, but the improvements in litter moisture and in-house conditions have been very significant in some of the houses that we have examined. Another major benefit is using attic heat for preheating prior to chick placement.

Data shared with Auburn University by the USDA-ARS Poultry Research Unit at Mississippi State University is used in this report to characterize attic, outdoor, and indoor temperatures during winter and summer months in the Poultry Belt. This published research data is consistent with the field observations we have made in several houses that have attic inlets. The USDA data indicates that the attic temperature was at least 10.8 degrees Fahrenheit warmer than the outside air temperature for at least 86% of the time during the first two weeks of a particular winter grow out. Auburn data often found attic temperatures in winter to be at least 15-20 degrees higher than outside air temperatures during the middle of the day, and often 7 to 10 degrees higher for the entire 24 hour period.

USDA data also indicate that in summer there is a very large supply of available heat in the attic of a poultry house. Attic temperature typically exceeds outside temperature by 30-35 degrees in the middle of the day. However, attic and outside temperatures are often almost equal during nighttime in summer.

The amount of fuel that may be saved by using solar assist and attic inlets is highly dependent on the time of year and the weather conditions. A typical grower who is growing a small bird size might grow seven flocks per year. Two of these flocks will be brooded in very cold weather, four will be brooded in moderate weather and one will be brooded in very hot summertime conditions. A typical grower who is growing a large bird size might grow only five flocks per year. One of these flocks will be brooded in very cold weather, three will be brooded in moderate weather and one will be brooded in very hot summertime conditions. Tables 1 and 2 on page 3 show conservative estimates of gas usage and savings by time of year for both small and large bird programs, based on actual Auburn University data and grower reports from several locations across the Broiler belt.

Initial Auburn field tests utilized actuated attic inlets installed on a new four-house farm in Central Alabama. These houses were 42 ft x 510 ft houses, dropped ceiling, tunnel ventilated and

Typical actuated inlet

The large roof areas of poultry houses make very good solar collectors, and use of attic inlets to get free heated ventilation air appears to be a powerful emerging tool in reducing fuel usage and costs in modern dropped ceiling poultry houses. Potential fuel savings reported on in this newsletter are based on use of controller-actuated inlets as shown here.

center brooded. Twelve actuated bi-flow clam shell inlets were installed in the brood chambers of these houses during the final stages of construction. The inlets were connected to a single ball screw-type inlet machine that was controlled by the poultry house controller. The house had perimeter ceiling inlets installed for minimum ventilation. The original idea of the test was to utilize attic solar heat during the first three weeks of the grow-out and then at the point of the grow-out where it became necessary to cool the house, the perimeter ceiling inlets would be used and attic inlet use would be discontinued.

During the first test in cold weather the two houses equipped with attic inlets used 17% less gas than the two control houses that were ventilated using only perimeter ceiling inlets. Litter conditions were much drier in the attic inlet houses and, in general, the humidity levels in these houses were noticeably lower. It became obvious that there was a definite advantage to having the solar preheating of air in wintertime.

At the conclusion of the first test, it was decided that placement of attic inlets only in a brood chamber was not the best approach. The house was then modified by repositioning the inlets and having a total of sixteen inlets placed in the house, equally spaced. Inlets were rated at 3,000 CFM each, meaning that approximately 48,000 CFM of minimum ventilation air could be drawn through the attic inlets. A second test was then initiated using the new attic inlet configuration. Inlets in the off end were closed with the exception of one on each side of the brood curtain (center brood). At flock turn out, attic inlets were opened in both off ends of the house. When bird age and weather conditions dictated that we would be in a cooling mode, attic inlets were discontinued (approximately three weeks of age).

In the second test during a mild weather flock, heating fuel usage in the test houses was 35% less than in the control houses. Houses were heated with natural gas and meters were on all houses. Hot weather test data is not available at this time but the input from growers throughout the Poultry Belt supports expecting up to a 50% fuel savings during hot weather brooding conditions.

We are getting many inquiries about attic inlets; below are the most frequently asked questions and their answers.

Frequently Asked Questions about Actuated Attic Inlets

1. <u>How many attic inlets should be installed</u>? The number of attic inlets needed in a given poultry house is determined by the maximum CFM that will be utilized in minimum ventilation when birds are in the whole house. This is typically about 2 CFM per square foot of house. Inlets we know of that are on the market today are generally rated at 2,000 CFM (gravity types), 2,500 CFM and 3,000 CFM (actuated types). The table below shows recommendations based on our tests. <u>Be sure to install enough attic inlets to handle the air flow of the maximum number of minimum ventilation fans that will be used</u>.

House Size	Minimum Vent CFM	2000 CFM inlets	2500 CFM inlets	3000 CFM inlets
40x400	30,000	15	12	10
40x500	40,000	20	16	13
50x500	48,000	24	19	16
60x600	72,000	36	29	24

2. <u>Should attic inlets be used during nighttime</u>? Our attic temperature data showed that almost always at night there was an advantage to drawing air from the attic. Attic inlets are less affected by wind than side wall inlets. We saw no disadvantage to using attic inlets at night.

3. <u>If attic heat is free, should I then increase minimum ventilation run-time</u>? We have learned that we can get more benefit from installed attic inlets if we move more air through the house during periods of high attic temperatures in the middle of the day. The key thing to understand is that if the heat is free then minimum ventilation does not need to be minimum anymore. More fan run time is better when we can do it with warmer air that we are not spending gas to heat. More warm air and more ventilation decreases relative humidity and dries out the litter in the house, making it easier for us to withstand periods of really cold weather or high humidity when we do have to go back to the stingy minimum time clock ventilation. Drier litter allows us to approach really cold or rainy weather in much better shape than if we are running the bare minimum of time on our timer fans to conserve heating fuel.

4. <u>Do we need to monitor attic temperature either with a controller sensor or with a stand alone thermometer</u>? For actuated attic inlets, the best way to get maximum benefit is for the controller to operate the inlets based on the temperature of the attic. If heat is available and needed the inlets are used. If heat is not needed perimeter inlets are used. No grower intervention is necessary. If attic inlets are not on a controller, it is probably best to not use them in very hot conditions or house overheating can occur.

5. <u>What type of air flow can be expected</u>? At a static pressure of .07, warm air was directed all the way to the side walls of our test houses. Our initial observation on attic inlet houses is that high static pressures are not neces-

Example Estimated Gas Savings Using Actuated Attic Inlets

Table 1. Estimated Gas Savings Example for Small Bird Grow Out (7 flocks/year)
Annual Gas Usage 5,200 gallons/year – Improved Housing – North Alabama Conditions

Flock No.	Weather	% of Annual Consumption	Gallons	Projected % of Fuel Saved	Gallons Saved	@ $2.00/gal Propane
1	Cold	24	1,248	15	187	374.00
2	Cool	15	780	20	156	312.00
3	Hot	8	416	25	104	208.00
4	Very Hot	6	312	40	125	250.00
5	Hot	8	416	25	104	208.00
6	Cool	15	780	20	156	312.00
7	Cold	24	1,248	15	187	374.00
Summary	-	100	5,200	-	1,019	2,038.00

1,019 gal / 5,200 gal = 19.6% of fuel saved on average per year

Table 2. Estimated Gas Savings Example for Large Bird Grow Out (5 flocks/year)
Annual Gas Usage 4,100 gallons/year – Improved Housing – North Alabama Conditions

Flock No.	Weather	% of Annual Consumption	Gallons	Projected % of Fuel Saved	Gallons Saved	@ $2.00/gal Propane
1	Cold	40	1,640	15	246	492.00
2	Cool	34	1,394	18	251	502.00
3	Warm	13	533	23	123	246.00
4	Hot	8	328	28	92	184.00
5	Very Hot	5	205	40	82	164.00
Summary	-	100	4,100	-	794	1,588.00

794 gal / 4,100 gal = 19.4% of fuel saved on average per year

Notes for Tables 1 and 2:

1. Estimated gas savings are based on actual Auburn University data and grower reports from several locations across the poultry belt.
2. In this economic analysis, conservative estimates of fuel savings have been applied to account for highly variable weather conditions that might occur during the preheating and brooding periods. No additional values have been applied for additional benefits related to the utilization of attic inlets.
3. Calculations assume improved housing (solid insulated walls, dropped ceiling, etc.) that pulls at least 0.13 inches of water column on static pressure test.

Note: Additional data and other information on attic inlets is available at www.poultryhouse.com

sary to get good airflow. Air velocities at the inlet were 700 to 800 feet per minute and in the range of 200 feet per minute at the side wall.

6. Do I need to modify the house so that I can pull air into the attic? Most poultry houses have not been designed with attic ventilation in mind but we have not so far seen any difficulties in bringing minimum ventilation air through the ridge cap, corrugation openings and slots above the bird board on the eave. We are recommending to growers building new houses that they consider having their builder lower the bird board by at least three quarters of an inch from where it meets the tin on the roof so that there will be ample space for additional attic air entry. As we learn more about attic inlet ventilation in broiler houses it is possible that additional roof vents and or gable vents will be needed to insure we have adequate air entry square footage to feed outside air into the attic for preheating.

7. How much management is required for using attic inlets? The theory behind the actuated inlets is that the Poultry House Controller will utilize attic inlets when needed and will utilize perimeter side wall or ceiling inlets when needed. Basically we will have two inlet systems in the poultry house, one for low level ventilation during cold weather and one for moderate ventilation during mild weather and during the middle of the flock before tunnel ventilation. While actuated attic inlets can be run manually, integration of the two inlet machines into the poultry house controller is highly desirable. Most controller companies now have software in their units to allow attic inlets to be used when beneficial and not used when they would be detrimental.

8. How will using the attic of a poultry house as a solar collector affect the useful life of the building? If attic inlets remain fully closed when no ventilation is taking place, there should be no effect on the house. If attic inlets remain hung open during a period of non-use, warm moist air from the bird chamber will chimney its way into the

attic, which will be very detrimental to the building, causing condensation, sweating, wetting of timbers, wetting of insulation, etc. Attic inlets must be managed closely and under no circumstances be allowed to hang in the open position or leak air into the attic.

9. Are manual (gravity type) attic inlets better than actuated inlets? Our feeling at this time is there is a place for both types of attic inlets. The major advantage of the gravity type inlet is lower initial cost and the major advantage of the actuated inlet is that grower intervention is not necessary. Gravity inlets require more intervention from time to time. Our feeling is that in the long run the actuated inlet will become very popular.

10. Are there any poultry houses that attic inlets should not be installed in? For attic inlets to provide real benefits, the house needs to be adequately tight. If a house can not achieve at least a 0.10" of static pressure (a 0.13" pressure would be desirable) during a standard static pressure test it will most likely be too loose to get much of a benefit from attic inlets. The tighter the house, the higher the percentage of air that is drawn into the house comes from the attic. Attic vents do not belong in Class C poultry houses

The Bottom Line

Specific fuel savings from using attic inlets will vary by prevailing weather conditions and number of flocks per year. The estimates in Tables 1 and 2 just from fuel savings alone indicate that initial investment in actuated attic inlets for a small bird operation will be recovered in slightly less than 2 years, and in about 2½ years for a large bird program. The payback period will be slightly less for gravity type inlets because of their lower initial cost. However, additional value is likely to result from maintaining drier litter, extending the in-house life of litter, and slight increases in flock performance.

Attic heat recovery appears to be a powerful emerging tool in reducing fuel usage and costs in modern dropped ceiling poultry houses. It cannot be over-emphasized that if attic inlets are neglected or improperly managed, wetting in the attic will occur, causing serious structural damage to the poultry house and its insulation. Also mismanagement or neglect during warm weather can cause bird chamber overheating and poor flock performance. As more data is collected and more field work is conducted, that additional information will be made available.

Thanks are extended to the integrated companies, equipment companies, service technicians, and growers who have helped us in our initial work with attic vents. We are especially grateful to the USDA-ARS Southeast US Poultry Research Laboratory in Starkville, Mississippi for their willingness to share data and collaborate with us on this study, and for input from the University of Arkansas.

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