Factors to Consider in Breeder House Ventilation Design

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The goal of breeder programs is to produce high quality hatching eggs from week 25-65 of the breeder's life. There are many items that contribute to the success of the production program. Some of these are egg size, shell quality, true fertility, hatchability, egg numbers, and cost of production.

Almost all of the positive attributes we are looking for can be affected by the in-house environment that both males and females experience during production. In-house environmental management can be a major factor in the operation of a successful program. Goals for in-house environmental management in the breeder hen house should be as follows:

1. Be at the right temperature and air quality within an accepted range so that birds will be within their zone of comfort for optimum performance.
2. Be at the same temperature throughout the house. Uniformity is critical.
3. Have the capability in the house (both heating and cooling) to maintain temperature consistently, so that weather extremes do not affect production or fertility.

A point to consider is this: We spend a tremendous amount of time and effort monitoring our breeder programs. We frequently weigh males and females to determine if they are on the correct point on the weight curve for maximum performance. Feed quality and rations are formulated according to body weight to maximize performance. However, a major oversight in many programs is not taking into account the effects that in-house environmental factors, especially temperature, have on the program. If conditions inside the house are not maintained within acceptable range, the feeding program cannot deliver its intended performance level.

When rations are formulated and feeding programs designed in the breeder phase, the goal of the nutritionist is to provide the energy and protein necessary for body maintenance functions plus an ample amount for egg production. And for males, the goal is to provide feed necessary for body maintenance plus reproductive activity and semen production. For both males and females a portion of the feed for maintenance is utilized to keep the bird comfortable. If the house environment is too cool, more calories are spent generating metabolic heat to stay warm. If the house is too warm, more calories are spent in labored breathing and panting.

Either condition will result in lowered performance. Since bird heat tends to keep the flock and the house warm enough even in fairly cool weather, dealing with too-high air temperature is the most common challenge. It is especially important to prevent birds from reaching the stage of panting to relieve internal heat build-up. Too-high temperatures very quickly show up in reduced shell quality, fertility, and production. Obviously temperature extremes, either hot or cold, can also affect the rate and quantity of feed consumed.

Integrated company breeder programs vary somewhat, and there will always be some variation from flock to flock and from time to time, but field experience indicates that temperatures close to 70-72°F usually produce best performance. Note that this is the “effective temperature” we would like the birds to experience. In warm weather we often cannot reduce actual air temperature that much, but we can use tunnel ventilation wind-chill along with evaporative cooling to make the birds feel as though the thermometer was reading 70-72°F.

Maintaining temperature consistency and uniformity throughout the house is equally as important as targeting a precise optimum temperature. There is always some variation in temperature through the course of a day or night, week, etc., and from one end of a house to another. But a flock that experiences only one or two degree differences up or down, around even a not quite optimum target will perform better than a flock experiencing large temperature swings around and “average” temperature that is precisely on-target.

Environmental control systems for poultry houses have evolved so that we now have a practical and cost-effective means of controlling in-house conditions for consistently optimum flock performance. House designs will vary based on location and climate. From an engineering standpoint, if a house was to be designed from scratch, a complete heat flow calculation should be done looking at all building surfaces, insulative values and climatic extremes. Also because breeder programs vary widely among integrated companies, it is more difficult to find agreement on a standard ventilation system design for a breeder house than it is for, say, a broiler house.

However, for programs operating in the southeastern United States where summer climates are hot and winters can be cold the following environmental control elements are becoming the industry standard. There are four items in these designs that allow this house to out-perform conventional houses in providing consistency of temperature and the ability to handle climatic extremes. Specifically these items are as follows:

1. <u>Tunnel ventilation</u> – Houses located in hot climates should be well insulated to minimize heat coming into the house and they should be equipped with tunnel ventilation. It is desirable to attain a minimum air speed of 400 fpm in these houses. As birds grow larger they produce more body heat, and their mass to surface area ratio increases, making it much more difficult for them to shed heat. Adequate fan capacity allows us to remove heat build-up from the house, and air speed gives us the tool of wind chill cooling to keep large birds more comfortable.

2. <u>Recirculating evaporative cooling systems</u> – Breeder programs were the first in poultry to recognize the need for real cooling. While wind chill cooling is adequate to remove heat from large birds in fairly warm weather, in very hot weather birds need the combination of wind-chill reduction of “effective” temperature and lowering of the actual air temperature through evaporative cooling. As bird felt temperatures reach the upper 80s and above the risk of severely affecting production and fertility increases dramatically. Six-inch recirculating pad cooling systems are chosen because they deliver the maximum possible cooling. Virtually all houses recently built in Alabama have six-inch recirculating evaporative cooling. From a design standpoint, an important point to understand regard-

ing cooling systems is that it is very important to size the amount of pad to the installed fan capacity to achieve high efficiency cooling without raising the house static pressure to levels which impede house air flow (see Figure 1).

3. Sidewall vent boxes for transitional ventilation – In mild and cold weather, the ability to bring air in high above the birds and take heat out of the house without putting cold air directly on the birds is a powerful tool to achieve the goals of temperature uniformity and consistency in the house. This is an extremely valuable tool during cool nights in both spring and fall. New generation breeder houses in the South are equipped with enough sidewall vents to give the producer the capability of running three or more of the tunnel ventilation fans without opening the tunnel curtain. To ensure consistent results, vent openings are adjusted by static pressure controllers to match open vent area to fan capacity being used.

4. Forced air heat – in climates such as the southeastern United States temperatures can be extremely low for at least short periods in winter. During this time body heat may not be enough to keep the breeder house at an acceptable temperature level. Running minimum ventilation fans in cold weather, which must be done to remove moisture, of course brings house temperatures even lower. In the past five years, therefore, there has been a trend in some areas to add forced air furnaces to the equipment list for breeder housing. These heaters serve the goal of maintaining consistent optimum temperature, allowing us to keep a background temperature such that birds will never be exposed to extremely low temperatures, as often happens in conventional breeder housing in extreme weather.

Example Breeder House Design

Many of the factors that affect the design of a commercial breeder house have been mentioned. Perhaps the best way to get a feel for what the house might look like is to examine a typical set of specs and drawing. A sample house design plan view is shown in Figure 2, including calculations for key ventilation elements. A simplified set of specifications for this house is as follows.

1. 40 ft x 400 ft breeder house (does not include space for processing)
2. 9600 head capacity depending on program
3. Dropped ceiling - insulation R-19 or better - sidewall height 8 ft., center ceiling height 11 ft.; average ceiling height 9.5 ft.
4. Exterior curtain sidewalls - 54-inch curtain openings - clear curtain
5. Tunnel ventilation with recirculating evaporative cooling pad desired – minimum wind speed is 400 fpm. Install seven 48-inch fans rated 22,000 cfm at 0.05 inches S.P.
6. Minimum ventilation will be accomplished with two 36-inch fans rated 9000 cfm at 0.05 inches S.P. installed on sidewall
7. Enough minimum ventilation sidewall inlets will be installed so that three 48-inch fans can be operated without opening tunnel curtain.
8. Evaporative cooling will be 6-inch recirculating with sufficient pad area for maximum S.P. drop across pad to be .05 inches when in full tunnel operation. Design speed through 6-inch small flute pad will be 350 fpm. Tunnel inlet will be dog house with 2 ft clearance between pad and tunnel curtain.

Figure 1. Cooling efficiency and static pressure at different air velocities for a typical 6-inch small-flute recirculating cooling pad

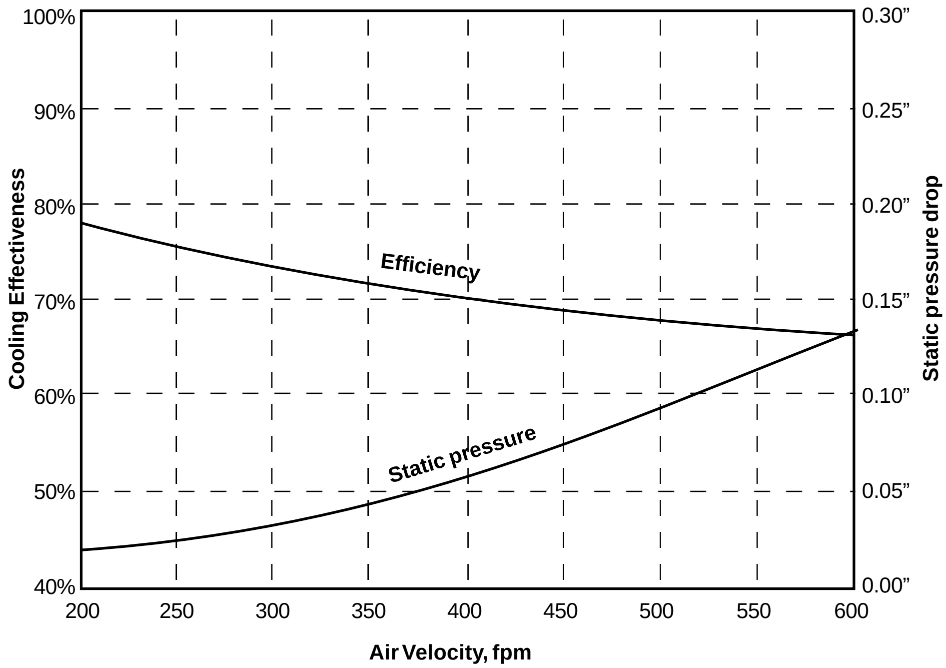
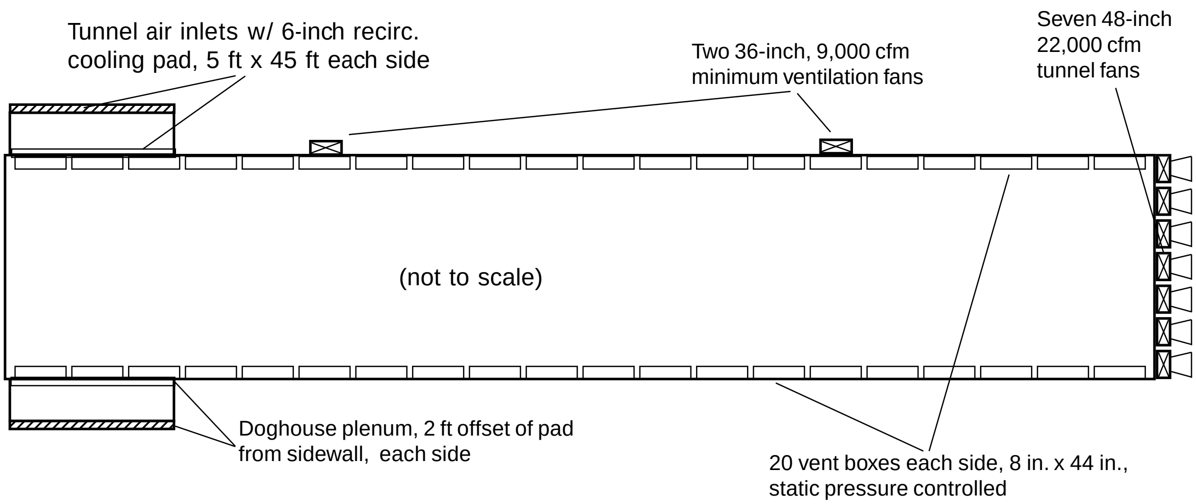


Figure 2. Recommended Typical 40 ft by 400 ft Broiler Breeder House
stocking approx. 9,600 birds



Design Calculations

1. Tunnel air speed
   400 fpm desired; choose fan that will produce this at 0.05 inches S.P. minimum
   400 ft x 9.5 ft x 40 ft = 152,000 cu ft
   152,000 cfm ÷ 7 fans = 21,714 cfm; choose 22,000 cfm minimum fan,or 154,000 cfm total installed fan capacity

2. Evaporative cooling pad determination
   154,000 cfm ÷ 350 fpm face velocity (6-inch small flute pad) = 440 sq ft needed for 0.05 inches S.P. or less drop across pad; Install 45 ft each side, total pad area = 450 sq ft

3. Number and size of minimum/transitional ventilation vent boxes
   Design based on ability to run three 48-inch fans with tunnel inlets fully closed: 3 fans x 22,000 cfm = 66,000 cfm
   15 sq ft of vent box needed for each 10,000 cfm of fan capacity to be used: 66,000 cfm ÷ 10,000 cfm = 6.6
   6.6 x 15 sq ft = 99 sq ft of vent box opening needed
   99 sq ft ÷ 2.44 sq ft (8-in x 44-in vent box area) = 40.57
   Install 40 vents, 20 on each side of house, equally spaced and staggered