Winter Ventilation for Broilers

By Martijin Gruyters, Senior Manager Technical Services, Cobb Europe

Progress in genetics, nutrition and management have made remarkable improvements in the daily growth and feed efficiency of modern broilers. The benefit of these improvements is a dramatic reduction the time a modern broiler takes to achieve market weight. Thus, for every hour in which the birds do not have optimal temperature and ventilation, valuable performance will be lost. The greatest challenges facing any producer is understanding the constantly changing comfort zone requirements of the broiler life cycle, which can also vary depending on the region of the world and season. However, during the winter, when outside temperatures drop significantly, tremendous challenges arise between maintaining target temperatures without forfeiting optimal air quality.

House sealing

It is nearly impossible to properly ventilate or control temperatures in a poultry house if it is not properly sealed. Any cracks, leaking fan shutters, poorly sealed inlets or poorly installed roof insulation will reduce the ability to control static pressure. Poor static pressure control means a large percentage of the fresh air entering the house will be through leaks. In this case, to achieve the correct air volume and velocity across the inlets will require more fan capacity and will result in over ventilation and increased heating costs making it difficult to maintain target temperatures, particularly at night. Moreover, leaks are sources of cold drafts, which may potentially cause health issues for birds and wet litter.

Photo: Cobb Vantress Inc: "Air Inlets in a house"

The vast majority of modern side wall fans have shutters mounted on the inside which can be easily sealed with a simple sheet of plastic placed between the shutter and the frame during winter. The larger cone and box type fans used for summer ventilation can also be effectively sealed with a plastic cover on the outside. The negative pressure created in the house will pull the plastic against the fan shutters which further the seal. Large doors are also easily sealed by placing a large plastic sheet on the outside.

The following is a very simple pressure evaluation test. The fan or fans used for the test is based on house floor area:

1. Close all inlets and doors
2. Run the equivalent of 18m³/h of fan capacity per m^2 of floor area (eg 2000m^2 × 18m³/h =36000 m³/h of fan capacity). Depending on the fans installed, it is not always possible to get a perfect match.
3. Measure the static pressure across any small opening such as slightly opened inlet or hole.

A static pressure of >37.5Pa indicates the house is adequately sealed. Static pressures <25 Pa indicate a poorly sealed house which will require maintenance. A newly commissioned house should easily achieve a static pressure of 60Pa. Always record the results of your pressure tests for future reference.

Minimum ventilation
Minimum ventilation systems are designed to manage air quality levels and moisture using fans on a cycle timer. This system is independent of the temperature control system and needs to be designed and operated in such a way that it will maintain good air quality and moisture control for optimal broiler development.

Three factors of minimum ventilation to consider are:

1. *Continuous genetic improvements result in a higher metabolic and growth rates which in turn increase oxygen demand. These increased metabolic rates also mean increased metabolic heat production, moisture deposited in the litter via the feces and levels of CO_2 production, all of which needs to be removed by the minimum ventilation system.*
2. *Due to the increased heater run times during winter more stress will be put on the minimum ventilation system as there are more waste gases produced from the heating system*
3. *During wintertime there is a tendency for producers to reduce minimum ventilation rates as a means of maintaining temperature and reducing energy costs.*

Air quality parameters for poultry can be defined as:

Air quality guidelines	
Oxygen %	>19.6%
Carbon Dioxide (CO_2)	<0.3% / 3000ppm
Carbon Monoxide (CO)	<10ppm
Ammonia (NH_3)	<10ppm
Inspirable Dust	<3.4 mg/m3 (.0001oz/35.3 ft^3)
Relative Humidity (RH)	<70%

During winter, it is particularly challenging to meet these parameters due to the dilemma between maintaining temperature and optimal air quality. When heating capacity is limited there is a tendency to reduce the minimum ventilation to prevent heat loss. At the same time CO_2 levels and relative humidity (RH) will increase which will have a negative impact on the development of the bird and the litter conditions. The correct programming of the minimum ventilation is the only effective method to control these parameters.

The importance of controlling CO_2-levels
Oxygen is an important component in physiological processes and birds will require a minimum level for optimal performance. In a poultry house, CO_2 is continuously added to the environment by the birds and heating system, particularly in winter and brooding with constant heater usage.

The CO_2 levels should be kept below the maximum range of 3000 ppm as increasing levels of CO_2 will displace oxygen in the house.

When CO_2 levels exceed the maximum level of 3000 ppm or 0.3%, oxygen availability will be low resulting in inactive birds, reduced feed and water intake and a higher risk for the development of ascites.

Photo: Cobb Vantress Inc: "Air Inlet in a house"

The importance of controlling RH levels

Like CO_2, moisture will be added to a poultry house mainly by the birds and gas heating systems. Birds will add moisture through respiration, drinking behavior and excreta. The combustion of $1m^3$ of gas adds 1 liter of water vapor into the air. If this added moisture is not removed from the house the relative humidity (RH) will increase and cause wet litter problems. The RH needs to be kept below 60% whenever possible. The only means to remove this excessive moisture is by increasing air temperature and air exchange rates. As air temperature increases, its moisture holding capacity will also increase which significantly increases the amount of moisture that can be removed by the minimum ventilation system.

Importance of the inlets and heat circulation systems

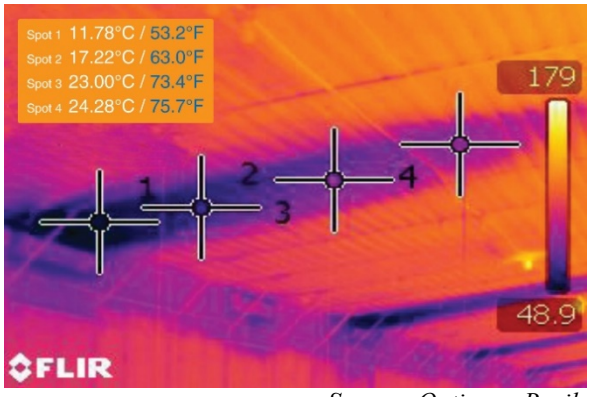
Inlets are arguably the most important part of the house ventilation system. Positioning and design of the inlets will significantly impact the direction of the incoming cold air. In many regions of the world outside winter air temperatures are low with potentially high levels of RH. This cold moist air needs to be heated before reaching bird level. Due to stratification air temperatures are always the hottest at the peak of the ceiling or roof. Incoming cold moist air needs to be directed to the peak and mixed with the hot air before reaching bird level.

In cold weather air inlets should only open from the top directing the incoming air to the peak of the house. Poorly sealed and designed inlets that leak from the sides or base direct a significant amount of cold heavy air onto the floor. This cold air is a source of drafts and wet litter.

The opening of the inlets should always match the fan capacity and generally have a minimum opening of 5cm to produce an optimal air jet. A smaller opening will not produce a strong enough air jet that is capable of reaching the center of the house. For optimal air distribution the incoming air needs a smooth surface to flow along to ensure it reaches the center of the house where it can mix with the hot air in the peak of the roof.

During the brooding stages not all the inlets are used so that a minimum opening of 5cm is achieved. It is always best to ensure that opposite pairs of inlets are open or closed for an optimal airflow. Any inlet which is not in use should be properly closed because leaks result in pressure loss.

Inlet openings should be pressure controlled to maintain a constant airflow at different fan capacities. When cables are being used to operate the inlets, special attention needs to be given to the nylon cords which are closing the inlets. Cables can stretch and are prone to cause uneven openings. Inlets that do not close completely will cause pressure loss and energy loss. An 8 mm steel rod is the preferred material to be used when installing the inlets. (See image X)



Source: Optimum Broiler Development Guide Cobb-Vantress, Inc)
Caption "Air temperature is rising the air gets closer to the ridge. Photo: Air Flow

There many different designs and setups for circulation fans. The primary function of a circulation fan system is to break up the natural heat stratification in the house. It is not unusual to see up to 10°C difference between the ceiling and floor level. These systems are designed to mix the air from floor to ceiling and remove significant levels of moisture from the litter.

Check list to prepare for winter time:

- Properly seal all fans which are not in use during ventilation in wintertime.
- Seal tunnel inlets when not in use during wintertime
- Perform a leakage test to check for house sealing
- Make sure all inlets are completely closed
- Check all nylon connectors and cords, any connectors which is broken or bad quality should be replaced.
- Make sure front door seals well or provide additional sealing after receiving the birds (with wood shavings or plastic coverage).
- Check operating system settings (P-band, summer offsets etc) and make sure these are set for the winter period (cold air correction, RH correction etc).