Fuel and feed cost rises

For the third series of our Aviagen articles we have returned to International Poultry Production to address important basic principles of managing the environment within a poultry house or hatchery.

This topic has been chosen at a time when the direct (fuel) and indirect (feed) costs of energy inputs for poultry production continue to show significant increases. The cost of crude oil has risen significantly which in turn stimulated the production of biofuels. The latter compete directly with animal feeds for traditional food crops and so push up the prices of finished feed. Thus, managing the environment of the chicken house effectively can both save the direct input costs of heating (or cooling) and also the feed amounts and therefore costs which are used by the birds.

Having the correct environment for each age and type of stock is necessary to maintain the health and welfare of the birds, to ensure efficient use of all inputs and thereby to give the best cost of production

Fundamental to the effective management of the environment in a poultry house or hatchery is an understanding of some of the principles of physics and engineering and also the biological responses of the birds to environmental challenges. Therefore in this series we will address some of these fundamental principles and attempt to describe them in ways which can be easily understood.

Maintaining the optimum environment is even more critical as the growing time for broilers reduces. The period during which the birds are developing their own ability to regulate their body temperature is an increasing proportion of the time to grow a 1.8-2.0kg bird, which is still a preferred size in many broiler operations worldwide. During the past 15 years hatchabilities have tended to plateau around 85% of eggs set and therefore better environmental control and delivery of ideal incubation conditions throughout the incubation period provides one opportunity to effect improvements in hatchability.

Therefore in this series of articles we will consider some of the basic underlying principles which are relevant to successful management of the poultry house, hatchery and incubator environments. Articles will provide an understanding of the importance of temperature (dry bulb), humidity (wet bulb) and air movement and the interaction of these (effective temperature – as experienced by the birds or eggs). Different systems of environment control, positive and negative ventilation systems and the difference between ventilation and air circulation will be described.

Throughout these articles we will refer back to the five simple principles which were outlined in the first of the articles in 2006 since these are also critical to environmental management.

Wherever possible 'Keep it Simple' always 'Pay Attention to Detail' and 'Know What Happens'. In management of the environment 'Fix the right problem' is critical. Only by knowing exactly what is happening and having good solid data to support this can we be certain that we are addressing the real problem and the one which will give the most cost effective return. The last of the five principles, which in truth is the most important, is 'Do it for the bird (or egg)'. In a livestock industry it is critical that management activities are all targeted primarily at improving the conditions for the bird (or egg). In terms of ensuring customer satisfaction, the bird is the number one customer for the house manager.◆

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by Ken Laughlin, Group V. P. Policy and Strategy

Negative pressure

What is it, how do we use it?

In simple terms, when a fan extracts air from a house, a partial vacuum (negative pressure) is created within the house. Outside air tries to get into the house through any possible opening to replace the air that has been extracted.

The good thing about this is that, under a negative pressure, air will enter uniformly through every ventilation inlet, the bad aspect being that it will also enter through every leak that exists

However, it is important to realise that just because there is a fan running, it doesn't necessarily imply that there is a negative pressure in the house.

If the 'leakage capacity' of the house, and/or inlet opening, exceeds the operating fan capacity, a partial vacuum will not be created. Thus, a well sealed house is extremely important when trying to use a negative pressure system.

Air will always take the path of least resistance. Without a negative pressure in the house, air will be drawn from the closest available inlet, or leak, to satisfy the fan demand.

As a result, while you may think you are ventilating the entire house, in fact only the area in the vicinity of the fan is being ventilated.

Once a negative pressure is created, air will be drawn equally through every inlet. So, provided the inlets are evenly distributed, there will be an even distribution of fresh air entering the building.

Negative pressure can be used not only to control where the air enters a house, but how it enters. As the negative pressure increases, so does the speed of the air coming through the inlet. If the pressure is too low, the air will enter the house at low speed and fall to the floor. During brooding, and when ambient temperatures are low, this could be disastrous. Chicks will be chilled and stressed, the litter may become wet, and the heaters will run.

In a house with side wall inlets, any time you are not trying to cool the birds, the ideal is to introduce the fresh, cool air along the ceiling (away from the birds) and up into the peak of the roof.

This is where all the heat accumulates. By regulating the pressure and hence the air speed across the inlet, the air can be thrown up into the peak of the roof.

The higher the air speed, the better the mixing of the cold incoming air with the warmer air inside the house, and the further the air will travel into the house. As the air warms, so its ability to absorb and hold moisture increases.

The negative pressure required is dependant on the inlet air

speed that is necessary to throw the air into the peak of the roof. The wider the house the higher the negative pressure required.

Therefore the ability to control where and how air enters the house are the reasons why negative pressure ventilation is the most widely used ventilation system. ◆

by Bernard Green, Poultry Consultant

Key components of minimum ventilation

Minimum ventilation is an important part of a ventilation system. What are the key components of a minimum ventilation system?

A well sealed, air tight house is absolutely crucial. This point cannot be over emphasised! The tighter the house is sealed, the more control you will have over your ventilation.

The house, and in particular the roof, should be appropriately insulated for the climate in which it is located, bearing in mind that a well insulated house not only keeps the heat in when it is cold outside, but also keeps the heat out during the warmer months.

To assist with air flow during minimum ventilation, it is preferable that the house has a smooth ceiling surface from the eave up into the peak of the ceiling.

If the house has exposed purlins or other obstructions, then one must carefully consider the type, and positioning, of the side wall inlets used.

Some minimum ventilation inlets will direct air better than others, so choose carefully when deciding on an inlet type.

Inlets with the door recessed will generally do a better job, not only of directing air where you want it, but will also greatly reduce the amount of air that spills out at each end of the door along the side wall and onto the birds.

If the house has ceiling obstructions, then ensure that the inlets have direction plates. These help to direct the air below the obstructions, and up into the peak of the roof.

There are a number of factors to consider regarding heating.

Decide on the heating type to be used, bearing in mind that radiant type heaters are best suited to get the heat where it is needed during brooding – on the floor. Ensure not only that you have adequate heating capacity, but also that the heat is well distributed throughout the house or brooding area.

Whether the minimum ventilation fans are chimney or side wall type, ensure there is adequate total capacity. The fans should operate on a cycle timer, and at all times, the inlet capacity must match the operating fan capacity.

There is a wide range of controllers available on the market these days, from simpler stage controllers through to significantly more complicated units.

First and foremost, choose one that you find to be user friendly, and that you will be able to use with confidence.

The controller is the key to your entire ventilation system and if you can't use it, flock performance may be compromised.

Amongst other features, the controller should have a cycle timer function, and have the ability to regulate the minimum ventilation inlets based on static pressure. As advanced as they may be, there is no ventilation control system available today that replaces the role of a good manager.

As such, the manager must form the vital link between the birds, house conditions, and the ventilation system.

Managers, with their stockman skills, must be able to interpret what the birds are telling them through their behaviour, and should recognise other tell-tale signs about the current state of their ventilation.

Then, if need be, they must know how to correct the house conditions through changes to the ventilation system in order to make and keep the birds comfortable. ◆

by Bernard Green, Poultry Consultant

Minimum ventilation tips

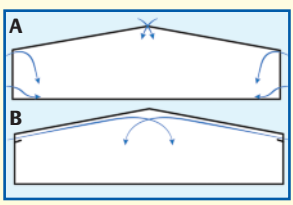
Minimum ventilation is a critical period as it is usually associated with young chicks and/or cold ambient conditions.

It is a time when sufficient fresh (cold) air must be introduced into the house while maintaining a desired temperature, and all the time ensuring that there are no temperature fluctuations or draughts on the chicks.

What can be done to manage this period more effectively? A top priority is to ensure that the house is well sealed! The tighter the house, the more control over how and where air enters, and where it goes once inside.

Check that all door seals are intact and the door closes properly. Fans that are not going to be used during minimum ventilation can have covers fitted to the outside to prevent air seepage through the shutters. In tunnel ventilated houses, a major focus area should be the tunnel inlet, particularly if this is closed with a curtain. Ensure that unused inlets close and seal properly.

Minimum ventilation fans should run on a cycle timer, with the side wall inlets operating at the appropriate negative pressure based on the width of the house.



A. Airflow and leakage in a poorly sealed house and, B, airflow in a well sealed house with good inlet management.

This ensures that the air enters at high speed to promote good mixing with the warm air in the house, and that it reaches the peak of the roof. Inlets should open equally, and those in use must be evenly distributed throughout the brooding area. If necessary, reduce the number of inlets used to ensure that they open at least 5cm when the timer fans are running. Fewer inlets opening the recommended amount is better than more inlets opening only slightly. Good inlet management is important!

Check that the inlet pressure settings are correct, that the static pressure and temperature probes are calibrated, and the temperature probes are in the correct place.

The heating and fan override set points should not be set too close. At what rate should you ventilate? Ventilate too little and air quality will be poor, moisture content will be high, and there is a good chance of condensation (wet litter) and high ammonia levels.

Ventilate too high and you face high heating costs, dry, dusty house conditions, and the risk of draughts on the birds.

There are a number of guides available covering minimum ventilation rates by age. They could be based on bird weight, relative humidity, or carbon dioxide levels. While such guides are useful, when implementing them it is advisable to regard them strictly as a guide. Ideally, the minimum ventilation setting should be determined by visiting the house daily, preferably each morning.

Assess the air quality within approximately the first 30 seconds of entering the house, before you become accustomed to the conditions. Based on this, bird behaviour, and other signs, decide on the change to be made to your minimum ventilation rate.

By recording daily data such as timer setting, percentage relative humidity, carbon dioxide ppm, perceived air quality, and bird behaviour, farmers could develop a minimum ventilation guide based on their own unique situation. ◆

by Bernard Green, Poultry Consultant

Tunnel ventilation

Tunnel ventilation consists of high capacity extraction fans (typically 50" (127cm)) at one end of the house and inlets at the other end, allowing air to be drawn down the length of the house. This system is aimed at cooling by high air movement and should only be used when transitional ventilation can no longer maintain bird comfort.

Two factors are considered when designing a tunnel system. The total fan capacity required depends on the desired maximum air speed, and is influenced by the cross sectional area of the house.

In addition, there should be adequate fan capacity to remove the bird heat load, whilst keeping the temperature gradient from inlet to fans at less than ±2.5°C.

The tunnel ventilation inlet size is calculated based on the total maximum operating fan capacity. If a cooling pad system is used, then the total pad area must match the total operating fan capacity. The tunnel ventilation inlet should operate on static pressure to ensure good distribution of the incoming air.

While tunnel ventilation may be the most powerful tool in dealing with hot weather, it may also be the most abused system if the operator does not take account of one very important concept, this being wind chill, or the cooling effect of air movement on the birds.

Birds feel a degree of cooling as a result of the combination of the dry bulb temperature, relative humidity, air speed, and the age of the birds. As such, we speak of effective temperature rather than actual air temperature. Wind chill effect is greater on younger birds and decreases as the birds get older, as illustrated in Fig. 1. Wind chill cannot be measured by a dry bulb thermometer or controller probe. Therefore, the number of fans running in tunnel mode at any time should never be based purely on dry bulb or probe temperature. At all times, this decision should be based on the visual comfort level of the birds. After all, why ventilate the house based on what a few probes are telling you when there are thousands of other 'thermometers' that may be telling you that they are too hot or too cold.

Too often when visiting houses in tunnel mode, one finds virtually every chicken in the house sitting flat on the floor, a 'carpet of chicken'. This could indicate that there are too many fans running, resulting in an effective temperature on the birds that is lower than they would like it.

In such a case it may be necessary to slow the air speed down (switch off a fan or two) to decrease the wind chill effect, even though this may result in a further increase above the house set point temperature.

When making the decision on how many fans to use, always take into consideration the comfort level of the birds throughout the entire length of the house. Running too few fans can result in a large temperature gradient from one end of the house to the other, and result in problems of its own.

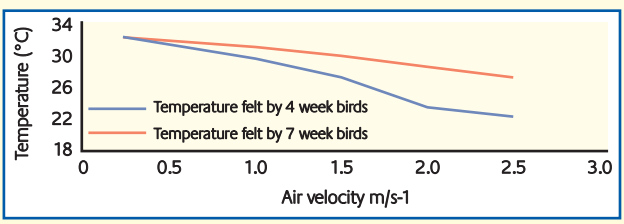


Fig. 1. Wind chill effect created by high velocity air flow is much greater for younger birds (Professor Donald, Auburn University).

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Evaporative Cooling

At some stage during hot weather, even the air movement of a tunnel ventilated house may not be sufficient to keep the birds comfortable. It then becomes necessary to cool the air to gain an additional cooling effect.

Evaporative cooling is the most effective, yet relatively inexpensive, method of doing this.

The cooling effect of evaporative cooling is achieved through a transfer of energy (heat) between the warm air and the water being evaporated in the cooling system.

The warm air transfers energy to the water and as a result the air becomes cooler. The energy that is absorbed by the water allows it to change phase from a liquid to a vapour.

This change of phase to a vapour increases the moisture content of the air.

Relative humidity (RH) is a comparison between the actual amount of water (moisture) present in the air at a particular temperature, relative to the maximum amount of moisture the air could possibly hold at the same temperature if the air were saturated (100% RH).

If the environment is very dry (low RH), the air has a large water carrying potential, and so the evaporative cooling system will be very effective because the water will be readily evaporated.

On the other hand, if the environment has a high RH, the system will not be as effective since the air is closer to being saturated and so there is less capacity for water to be evaporated.

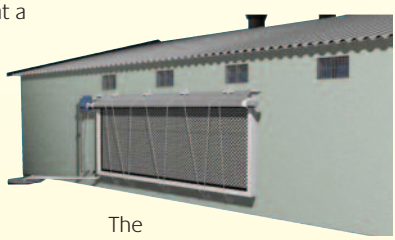
The warmer the air, the more moisture it can hold. The colder the air, the less moisture it can hold. For a given cooling system, the lower the ambient RH is, the greater the potential temperature reduction of the air.

Birds use evaporative cooling to remove excess heat from their body. With a bird's cooling system the evaporation of water takes place internally rather than on the outside. As the bird breathes, air passes over the wet surfaces of its respiratory system, and moisture is evaporated into the air. During hot weather, a bird starts to increase the amount of heat it loses through evaporation by panting.

The more air it passes over its respiratory system the greater the amount of water that can be evaporated and the greater the amount of heat that is removed directly from its body.

From this, it can be understood why it is so important to measure and monitor in-house RH when using a cooling system.

The operation of an evaporative cooling system adds moisture to the air and increases the RH within the house.



The birds too, by panting, increase the RH within the house.

As the in-house RH increases, so the effectiveness of the birds' internal cooling system (panting) decreases, and if the RH is allowed to get too high, this can result in mortality.

An evaporative cooling system should never be operated purely on temperature, but on a combination of temperature and RH.

A general guide is not to use evaporative cooling if the in-house RH exceeds 70-80%. ◆

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Getting the best out of your ventilation system

There is more to getting the best out of your ventilation system than just having the latest, most sophisticated controller and equipment.

Don't let anyone fool you, simply having the 'best' equipment on the market does not guarantee you great results. Equally, it does not mean that you can not get good performance from older facilities.

To get the best out of any ventilation system, it is necessary to have an understanding of some basic ventilation principles.

Education and training is important. Not everyone is fortunate enough to have the latest automated ventilation system, and so in more manually operated houses it is particularly important for farm staff to have a sound knowledge of the basic principles in order to set the house up for optimum bird comfort.

Farm staff should know how the current system is designed to operate and, in particular, how to operate the ventilation controller. Having the latest most sophisticated control system can be very beneficial, but if you do not know how to operate it, it can do more harm than good.

Many of the latest controllers are powerful tools if used properly.

This said, it does not mean that the farm staff should take for granted that whatever has been programmed into the controller is necessarily the right setting for their specific application.

Hence the need to understand the controller well enough to fine tune the 'standard' settings if need be.

Of course, stockman skills play an important role. The farm staff must be able to interpret bird behaviour/ comfort and house conditions, and then manage and adjust the ventilation system to meet their requirements.

A ventilation system should be properly designed, equipped, and installed to best cope with ambient conditions. If this is not the case, it can compromise performance.

Common to all stages of any ventilation system is the house, and here it is crucial for the house to be air tight.

The more air tight the house is, the more control there is over the ventilation system, how effectively it operates, how it is used, and the less impact the ambient conditions will have on internal conditions (to a large extent).

In older houses, every effort should be made to seal the house. Ideally, house sealing should be of a permanent nature, however, if time or money does not allow this, then even the use of temporary measures (for example stuffing paper into cracks and openings) can make a huge improvement and is better than nothing at all.

Along with air tightness, is the need for a suitably insulated structure. The more the influence of ambient conditions can be reduced, the better the internal environment and bird comfort can be maintained in both summer and winter.

Properly maintained ventilation equipment (fans, winches, inlets, cooling system and heaters) contribute to the successful operation of a ventilation system.

Attention to detail in every aspect of the set up of the house, equipment, settings, and the day to day comfort of the birds contribute towards a successful farming operation. ◆

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