Ventilation in poultry production is more important than previously thought. Fast growing birds need plenty of dust and germ free fresh air as well as comfortable temperatures. What systems are available to maintain a good in-house climate?

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Ventilation is more than just replacing air. If it were that simple it would not be considered to be one of the major issues in good poultry housing and management. Ventilation is an integral part of climate control and includes a number of systems to choose from. In poultry husbandry one may find open and closed houses. Open houses usually do not require special ventilation systems, unless during high temperatures, hot air must be removed from the house. Closed houses can be divided in houses with natural ventilation and forced ventilation. In the latter one has a range of ventilation options:
- ridge ventilation
- cross ventilation
- tunnel ventilation
- systems with integrated manure drying facilities.

Open houses
Open houses are generally defined as houses in which the climate inside the house is similar to the outside climate. In the past this type of housing could be found everywhere, but today it is mostly found in warm climate zones. Here these houses are often characterized by roofs with a large overhang to prevent the sun and rain from entering the house from the sides. Often the sidewalls are 50 cm to 1 m high, while the rest of the sides remained ‘open’ but covered with wire mesh. In some regions you may even find houses with brick walls with many openings.

In open houses it is practically impossible to control the climate because temperature and ventilation depend on the weather. Should heating be necessary (e.g. for day-old chicks) local (space) heaters can be used. Of all poultry houses, open houses have the lowest construction costs.

Closed houses
Closed houses are defined as houses in which there is a difference between the inside and outside climate. Climate control is possible in these houses and there is usually a ventilation system in use. The ventilation systems used can be divided into two main groups: natural ventilation and forced or mechanical ventilation.

Natural ventilation: Closed houses with natural ventilation usually have louvers or curtains in the sidewalls to let air in and an open ridge to let the air out. Both the louvers/curtains and the ridge can be operated either manually or automatically.

Natural ventilation is based on the principle that warm air is light and rises and cold air is heavy thus ‘drops’. The warm air rises and leaves the house through the ridge. Together with the venturi effect of air that passes over the roof of the house the pressure inside drops and cool air from outside is pulled in. In addition, when the curtains are open, the wind can move freely trough the house.

Natural ventilation has a few advantages, such as low energy costs, it functions irrespective of power failures and the investment costs are usually lower than those for forced ventilation. However there are a few drawbacks.

The biggest drawback of natural ventilation is that it is very dependent on weather conditions (e.g. if it is a hot, windless day, there is hardly any ventilation possible). It is also difficult to accurately regulate the ventilation capacity. The maximum ventilation possible with natural ventilation systems depends on the position of the louvers in the ridge and the sidewalls of the building. In addition to these factors it also depends on:
- the slope of the roof
- wind direction and wind speed
- temperature difference between inside and outside. Generally speaking and contrary to what one may expect, houses with natural ventilation systems are not suitable for hot climates. Natural ventilation is also not suitable for those houses in which accurate control of temperature, humidity and air quality is crucial, such as broiler houses in temperate climates. In hot climate zones one cane make use of open houses or closed houses with mechanical ventilation and cooling systems.

Mechanical ventilation: There are three...
main groups of mechanical ventilation, depending on the location of the fans: ridge ventilation, cross ventilation and tunnel ventilation. Ridge ventilation is mainly used in moderate or cold climates. With this system the fans are placed in the ridge and the air inlet in the sidewalls. The advantage is that there is less risk of cold air descending on the birds in winter. The disadvantage is that a lot of the equipment (fans in the ridge) used is difficult to install and clean.

Cross ventilation is mainly used in locations with extreme temperature differences and in double storey barns. Several fans are placed in one of the sidewalls. In the opposite sidewall one can find the air inlets. When using just a few large fans in the sidewall the pattern of the air movement is not ideal because of the creation of ‘dead spots’. (Figure 1)

Tunnel ventilation is an ideal system for regions with high temperatures. The principle looks similar to cross ventilation but now the fans are placed at the back end of the house and the air inlets are in the two sidewalls or in the opposite end of the house. The system is based on the principle of cooling through high wind speeds. Large fans quickly extract high air volumes from the house at high speed providing a cool breeze, especially if, during the hot hours of the day, additional cooling is applied at the inlets. (Figure 2)

Fans types
Most fans used in the poultry industry are of the axial type and have a propeller with 3 to 6 blades. Compared to the centrifugal fans their capacity and efficiency is higher but their possibility of creating a high negative pressure is not very high (Table 1).

Generally there are two types: The ‘small fans’ with a maximum diameter of 75 cm. These fans are direct driven, which means that the motor is directly connected to the propeller. They have a high number of RPM and speed is easy to adjust. The advantage however is that their electricity consumption and price are lower compared to the smaller fans. These large fans are mainly used in tunnel-ventilated houses.

Air inlets
Many believe that fans are the most important part of a ventilation system. But this is incorrect. Fans are important, but they only handle removal of (a given amount of) air from the building. In climate control it is more important how and from where the air is removed than how much. The source of most problems in mechanically ventilated houses therefore is the way air moves through the house, which means that these adjustable holes play a dominant role in the functioning of a ventilation system. With fans we can regulate the amount of air and with the air inlet we can fine-tune the way the air moves through the house. It is very important to have the correct fan speed and the correct position of the air inlets under given circumstances to obtain the correct air movement in the house. For that reason some farmers control the position of the air inlet by measuring the under-pressure in the house. To avoid a cold airdrop on the
Air inlet options

Curtains are the cheapest type of inlet. They are used for houses with natural and mechanical ventilation. Curtains can be used for animals that do not need very precise climate control. They can be controlled manually with a winch, but in areas with temperature fluctuations and big temperature differences between day and night, automatic control of curtains is preferable.

With air inlet flaps, which usually are made of wood and positioned alongside the sidewalls, it is possible to adjust the amount of air, but more importantly also the direction of the air. During the winter, cold air descending on the birds can be prevented with the help of flaps. However, when outside temperatures are high it is very difficult to bring the fresh air to bird level.

An air inlet flap with summer valve may reduce this disadvantage. These flaps have an extra small valve under the main board (Figure 3). During high outside temperatures the main flap will be closed and the small one opened so that the incoming air is directed alongside the wall at a high speed towards the birds.

Flaps that can overturn can be another alternative for summer ventilation. They also can steer the air directly over the birds.

Modern directional air inlets are much smaller than the traditional flap inlets (See box). This reduced size forces air to come through at a much higher speed. The flaps can also direct the air downwards directly to the animals, providing a cooling effect in summer. With these small air inlets, it is much easier to adjust the exact amount of ventilation in winter, if the valves can seal the inlet well enough.

Small air inlets in the ridge are only of interest in cold and moderate climates. Here the inlet is in the ridge, whereby the incoming air is heated a little by blending with the warm air accumulating under the ceiling. These ridge inlets must always be used in combination with another type of air inlet because the total capacity of these air inlets is not sufficient during warm days.

Manure drying and ventilation

Ventilation in combination with manure drying systems is mainly developed for birds in cage systems or for broilers kept on a ventilated floor. These systems have been developed to dry poultry manure in order to reduce the smell, ammonia emission, flies, and the transportation cost of manure. Their efficiency however largely depends on temperature and RH of the air. The deep pit or high-rise house is the most commonly known system to collect and dry poultry manure. With the deep pit system the air for ventilation comes in through the ridge and moves over the manure in the huge pit under the cages.

It is then exhausted through fans in the sidewalls (Figure 4). Because the manure remains in the pit a long time (more than 1 production period) it will dry and decompose. This process has some disadvantages, such as:
- high ammonia and odour levels
- problems with flies and rodents, and
- the manure is sometimes not dry enough in moderate climates.

Canal houses have separated air and manure canals (Figure 5). The principle is the same as it is in deep pit houses, but here manure storage is only for one production period and the air is exhausted at the end of the house.

The manure belt with drying system is one of the relatively new inventions in poultry housing. The system was developed to reduce odour and to better control ammonia emission. It dries the manure while it is still on the belt under the cages. This drying process is fast and allows the producer to remove the manure once or twice a week.

There are different ways of drying manure on the belt:
- With a whisk - a plastic flap that moves constantly by means of a long metal pipe, to create constant air movement, drying the manure.
- With air tubes just above or beside of the manure belt. The air is blown through the pipes by means of a centrifugal fan. The air can be pre-heated a bit with the help of a heat exchanger or an air mixer.

In the search for systems that could reduce ammonia emissions the focus has not only been directed to layer houses but also to breeders and broilers. During the early nineties a few houses were designed in which the litter, and thus manure, could be dried while the birds were still on it. These houses consisted of a full slatted floor with a woven nylon belt on it. The belt allowed ventilation air to pass through so the litter on the belt could be dried very quickly. The advantages of this system were better technical results and less ammonia production. The disadvantages were more dust, labour for cleaning and higher investment costs.