Vol. 71 January 2009

Veepro dairy management

Ventilation to reduce heat stress

Good ventilation is a must

Ventilation is a complex concept. Cattle need oxygen. This enters the cowhouse with the (fresh) outside air. At the same time this air removes all kinds of waste gases out of the cowhouse, such as CO_2, nitrous oxide and H_2O vapour. But also gases released by the manure, such as sulfur dioxide and nitrate compounds. Supply and removal of the air can be controlled in two ways: naturally or mechanically.

Cattle housing usually has natural ventilation. Fundamentally there are two types of housing: (partly) closed or walled stalls and open barns. Dairy cattle can take low temperatures quite well. A cow's comfort zone is between about – 5°C and + 20 °C. In areas within this temperature range there are many open barns. They are all that cattle need. A roof and possibly a face and a rear side. If temperatures increase over 20 °C, the roof construction will at least provide the animals with shade. Cattle can simply make use of it.

Natural ventilation

By nature open barns have good ventilation. When housing animals in barns that are as open as possible you create a 'basic climate' that approaches the outside climate. This is most desirable but not always operable.

In (very) hot conditions shade is the animals' first need. They want to get away from the radiation of the sun. A roof is welcome, but in many cases not enough to find coolness.

Technically cooling is very well possible, but expensive, unless simple means are used. Here we can consider evaporators in combination with ventilators. Evaporation of the moist in the air will lower the air temperature. But we must prevent animals from getting actually wet. Evaporators work well only in high temperatures and low air humidity.

Natural and Mec

Inflatable curtains filled with air

Milk production (in kg)	Heat production (in wattage)	Ventilation capacity (m³/hour)
6.000	759	460
8.000	865	524
10.000	971	588

Table 1. Heat production and ventilation capacity of different production levels (building temperature 20°C; difference between temperature in building and outdoors: 5°C)

In areas that have severe winters open stalls may still be an option. In these parts the summers are often warm. Open barns without walls may be used and are even recommended. Inflatable or retractable walls are good methods. That way ventilation can be regulated. Closing the walls in winter keeps out the worst cold. The high heat production of the animals themselves will usually keep the housing sufficiently warm, even in below zero temperatures outside. Additional heating is hardly ever required. When the frost has gone, it is recommended to open up the walls or all the windows of the barn as soon as possible. This decreases the air humidity. It lowers the risks of an outbreak of influenza and mastitis.

Enormous heat production

The enormous heat production of dairy cattle is related to their production. Table 2 shows the quantities of heat and moisture that cows and calves produce. The quantity of moisture depends on the milk production, too. Basically animals have two ways of losing heat to the environment:

- by evaporation of moist (sweating, breathing)
- by losing heat to the air around them.

A mature cow exhales about 12 litres of water vapour into the air each day. Ventilation has to remove that heat from the barn.

Milk production

The higher the milk production of cows the higher the ventilation capacity that is required. Table 1 shows the air ventilation capacity per cow per hour for different levels of milk production. These figures can be used for a rough calculation of the ventilation capacity required for the whole barn. If for example the building houses 100 cows that each produce an average of 8,000 kg milk, then the ventilation capacity required is 52,400 m³/hour.

Maximum difference of 5 degrees

Differences in temperature inside buildings with inlets of fresh air must not become too high. The incoming air and the air in the building should not have temperatures that vary more than five degrees Celcius. A cowhouse with a

Table 2 Surface, heat production and humidity

animal	weight	milkproduction/ day/growth	surface of the body	heat prod/watt	production gr H_2O hour
calf	45	500 grammes/day	0.92	110	40-100
cow	500	10 kg/day	5.67	800	250-700
cow	500	30 kg/day	5.67	1150	300-750

Natural ventilation

- Norm natural wind speed: 0.5 m/s air speed
- Dependent of wind through natural ventilation shafts
- 4-row cubicle: 0.5 m/s wind through an inlet that is 3m high will result in an air replacement of about 1,800 m³/cow
- Maintain sufficient air speed at cow level
- Air speed is the only way to cool down the cow.

Ventilation in walled barns

In areas where temperatures may drop under – 5°C walled cowhouses are more common. Here good ventilation is essential. Important factors ruling the ventilation in walled barns are:

- Air outlet
- Air inlet
- Volume of the building
- Slope of the roof
- Difference in height between inlet and outlet
- Heat production of animals
- Difference between cowhouse temperature and outside temperature
- Wind

In order to create an air flow in a barn there must be a a difference in temperature, especially when there is no wind or little wind.

hanical ventilation

Ventilators replacing air

In cattle housing natural ventilation is most common, but these days a lot of use is made of systems that support the flow of air. They make the air in the barn homogeneous. This avoids different temperatures and differences in the speeds of air flows. In other words: they prevent draughts. Support of the flow of air is done by for example HVLS fans. Although these 'ventilators' set a lot of air in motion they do not make a direct contribution to the ventilation. That is why this type of fan, like the axial fan, is not considered a system of mechanical ventilation.

large volume of air per animal has a high buffer capacity and will therefore "not very quickly" be heated up by the cattle. Another advantage is that there is less chance of draughts.

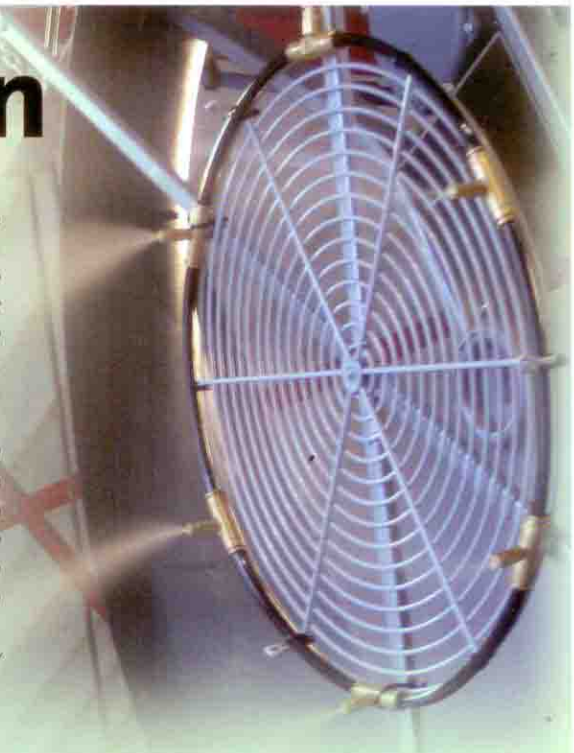
Mechanical ventilation

When the outdoor temperature rises above 25°C, mechanical ventilation can provide the solution. The use of special high capacity fans can reduce the ambient temperature by anything from 2 to 6 degrees, thus resulting in improved heat emission. This is usually adequate to retain a high milk yield.

Water cooling

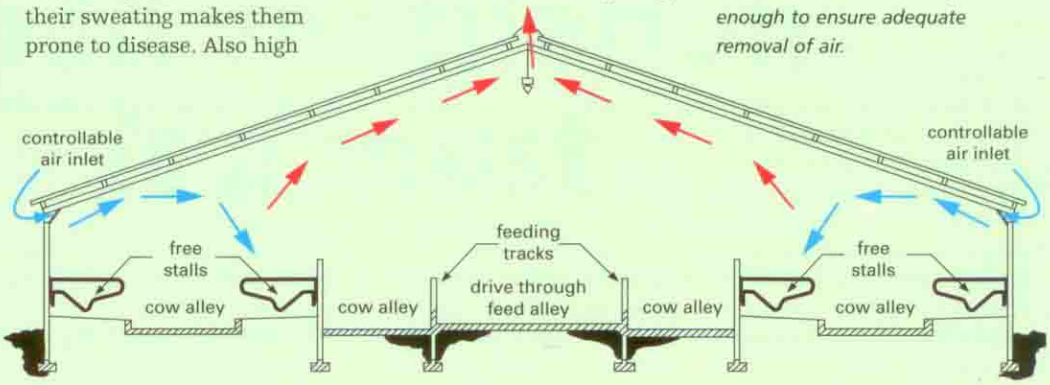
Additional cooling can also be achieved by fitting a combination of fans and a sprinkler system. Fans can also be installed in the gables, to draw air in at one end of the shed and expel it at the other end. This type of system can provide even greater cooling capacity if used in combination with a cooling system with cooling pads.

Information: Aerotech Europe BV



Draught has a disastrous effect on cattle. We talk of draught when there is a flow of air with a high speed that has a temperature of more than 5 C° lower than the air around the animals. Especially in high temperatures draughts pose a threat to their health. They are doubly liable then because their sweating makes them prone to disease. Also high production animals are most susceptible.
The illustration shows a cross section of a traditional cubicle house. This type of cowhouse has a limited volume and it is therefore soon heated up and sensitive to draughts. This is harmful for cattle. The outside air does not enter the cow house far, it falls quickly and causes a draught in the cubicles (blue arrows). When there is little wind the warm air from the building cannot easily escape through the small shaft under the roof (red arrows).

The air inlet openings should be enough for the supply of fresh air. The air outlet must be large enough to ensure adequate removal of air.

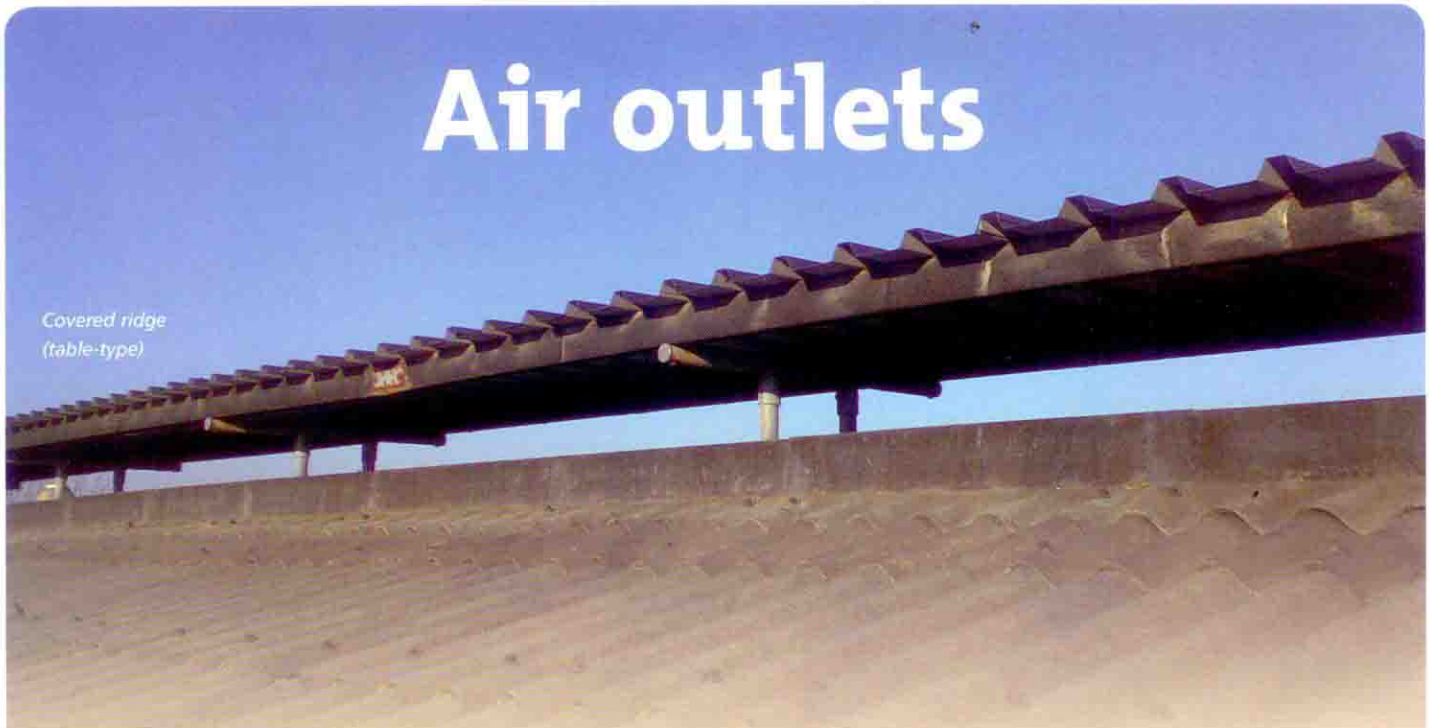


Cow suffering from heat stress

Effects of heat stress

•Blood supply to internal organs	goes down
•Milk production	lower by 10 – 25%
•DM intake	lower by 10 – 15%
•Rate of feed conversion	goes down
•Reproduction	goes down (embryo dies during the first 8 days)
•Resistance	goes down
•Respiration	faster
•Rectal temperature	goes up
•Water intake	higher intake
•Sweating	becomes worse
•Claw disorders	worse

Air outlets



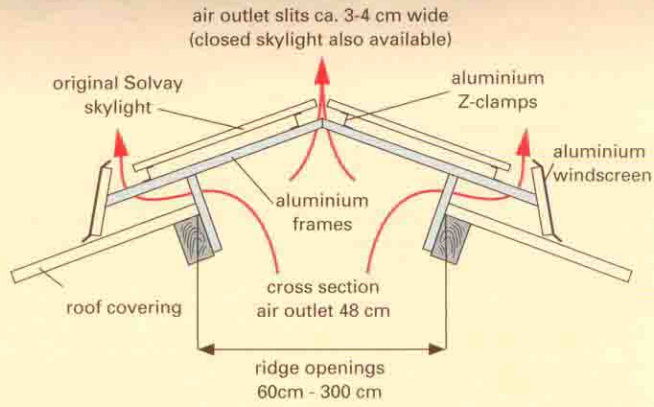
Covered ridge (table-type)

What cowhouses with natural ventilation really need is efficient air outlet. In windy weather modern barns with open walls have so-called cross-ventilation; the driving force of the wind on an endwall makes one of the sides act as the air outlet. But in order to have good ventilation at less windy times we need an open ridge. Especially when there is no wind and when conditions are warm and humid it is important that the heated air is removed properly. The only and right place for this type of outlet is the ridge on the roof of the cowhouse. A simple and open ridge with high top-pieces (35 cm) is one of the systems that works best. There is only one thing against it: it lets the rain in. This is worst when the cattle are under the ridge, but of course no-one likes rain in the feed alleys either.

Open ridge

In the course of the years people have invented ridge systems that ventilate well but are more or less rainproof. Still the best system is an open ridge with either a rain cover over the ridge (table top ridge) or upstands with drain pipes under the ridge. In these systems the air can rise freely when there is no wind.
Many other ridge systems are venturi-type systems in which the effective outlet of air depends on the wind. But in windy weather the ventilation is usually sufficient anyway.
So for good ventilation in bad conditions the type of ridge is crucial. For air to be drawn out of the building (in still weather) a number of conditions must be met, such as:

- right type of ridge
- right roof slope (> 25° slope)
- the height between the inlet and outlet
- finishing construction of the bottom of the roof
- no disturbance of the natural ventilation (by open doors etc.)



An open ridge with daylight through the ridge and optimal ventilation. In red the outlet of the air

Daylight through ridge

Some types combine open ridge and venturi-type system, but the ridge opening is rather small. For four-row cubicle houses an opening of about 30 cm is recommended. In cowhouses with insulating sandwich roof panels the ridge is an outlet for air as well as an inlet for light. That is why the covered ridges are often made by transparent material.
As an alternative to an open continuous ridge another type of ventilation (drawing out the air) is possible: through interruptions of the roof covering in the slope direction, for instance every 4 metres. These slits in the roof can easily be fitted with gutters that drain rainwater to the roofgutters.
Covered ridge (table-type) with extra light inlet (after renovating the roof timbers).

VEEPRO HOLLAND

Information centre for Dutch cattle

Veepro Dairy Management is a supplement to the Veepro Magazine. It contains articles, tips and advice aimed at the management of dairy farms.

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