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Trends in livestock housing ventilation

In closed housing for livestock, negative pressure air intake systems have established themselves. In modern pig and poultry housing the regulation of air volume flow takes place via ventilation computers connected with a PC. Substantial energy savings have been achieved, above all through new motor concepts with fans, through reducing air resistance in inlet and exhaust channels, and through the application of diffusers. Concepts of open housing on one or more sides, or large volume housing with eaves-ridge ventilation have become established in cattle housing. Free aeration in the form of cross ventilation is standard in poultry housing.

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Keywords

Inlet air flow, climate control, heating systems, energy saving

Central and decentral exhaust air systems are fitted in both pig and poultry housing. Because of the control technology required in modern buildings with larger individual compartments, the trend continues to favour decentral solutions. Central exhaust air channelling can be advantageous through creation of emission focal points, in the application of systems that transfer heat from exhaust air through heat exchangers, and in the design of the building. The number of compartments to be linked by any one system and the required performance are all critical for the dimensions of the exhaust air channel.

Inlet air introduction: especially via trickle ducts with perforated undersides

In the induction of inlet air, various types of forced ventilation have proved themselves. In practice, major acceptance has been won by trickle ducting with hole plate or hole plastic sheeting undersides. Also popular is passageway ventilation. Many types of hole plates have been already DLG certified. The trickle ductings are mainly made out of hard foam plates. This helps to avoid build-up of condensation in winter. The duct cross section must be large enough to prevent inlet air velocity exceeding 2.5 m/s. As a rule, this means the duct height is from 30 to 50 cm.

Hole plates must be chosen that do not offer more than 10 Pascal air resistance, and the air throughflow per m^2 of hole plate should be 250 to 300 m^3/h. With one-sided induction of outside air into the ducting, the length of the ducting should not be much more than 15 m. Where ducting is longer, a number of inlet openings are required. The ducting should not be affixed directly to building walls so that a rapid cold air introduction into the livestock areas is avoided.

Passageway ventilation in housing with smaller compartments

Passageway ventilation has its advantages in the future, too, especially where compartments are small. In its planning certain rules have to be observed. Thus, here too, inlet air velocity and passageway length should not exceed 2.5 m/s and 15 m respectively. In that the house passageway is actually serving as the inlet air channel, the pen separation walls must be at least as high as the air inlets. The air extraction point, must lie near the points of air induction. The pen depths should not exceed much more than 4.5 m.

Climate control from the desk

Where draught ventilation is applied only centrally-controllable air inlet elements should be operated. The temperature-dependent adjustment of the inlet elements takes place over a thermostat in association with fan speed control. This system especially suits poultry housing and larger pig buildings. Points to watch for are that air inlet velocity does not exceed 4 m/s and does not go below 1 m/s. Additionally, the room height:breadth ratio must be kept to a maximum 1:4.

The new generation of regulating instruments are already equipped with many functions including the possibility of operator-setting of desired temperature, digital readouts, different possibilities for controlling heat sensors, inlet and exhaust air flaps, alarm systems, humidifiers the programming for temperature splitting, etc. The

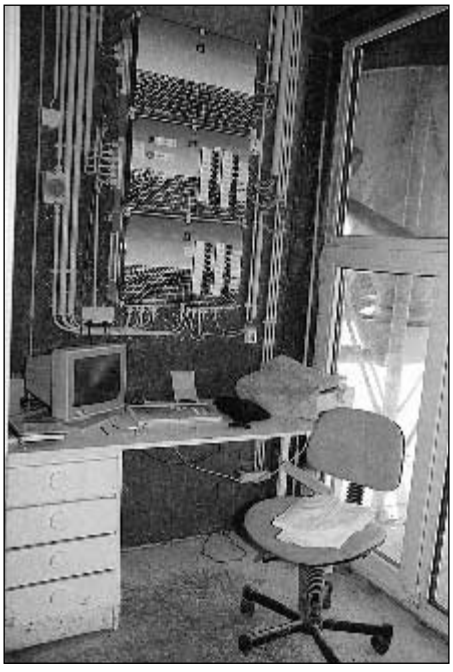

Fig. 1: Controlling the climate in feeding pig housing from the office

Fig. 2: Adjustable roller blinds allow a higher air exchange rate (photos: W. Achilles)

number of these functions can be increased still more substantially through the application of housing climate computers.

Thus, temperature curves can be set in association with livestock weight, to take account of relative humidity of interior air, record data and call it up, and much more. Additionally, the housing climate computer can be linked with other systems, e.g., the feeding computer, so that a temperature associated feeding and watering of the animals is possible. All manufacturers of housing climate computers also offer in the meantime ways of linking with a PC so that the possibility is there to check or alter the climate control from the desk.

More attention on the effects of energy saving

Energy saving effects and resultant cost savings will attract even more attention in the future. Important factors here include inlet air velocity, e.g., a maximum of 2.5 m/s in the ducting, the minimising of air resistance through baffle systems and rounding of ducting corners.With exhaust air channelling, exhaust-shaft diameter must be appropriate for the capacity of the necessary exhaust fans. Additionally, diffusers can substantially increase the specific air throughflow. New types of fans can have great influence on energy savings.Thus new motor concepts in enclosed areas can lead to savings of up to 60%. Important in the choice of fans is also the number and angle of attachment of blades, as well as efficiency degree.

Mainly gas heating in poultry meat production

Heating is a necessity in modern production systems and, because it is capable of matching the respective demands best, gas heating is preferred for poultry housing. Floor heating has established itself, especially with broilers. This ensures that the litter stays dry longer and therefore that emissions are kept low right through the cycle end. For piglet production there continues a trend towards hot water heating in the form of floor heating combined with electric infra red lamps in the farrowing pens. In larger sow herds with consistent heat losses through the year, central heating systems are popular.

Gas fan convectors or hot water heating with feeding pigs

Two types of heating are mainly applied in pig feeding systems. First of all, warmth created by gas fan convector can be evenly distributed through the housing compartments over insulated perforated pipelines. The gas fan convectors are easy to control. The system can be used with all air induction systems. Secondly, warm water heating has increased in recent years in livestock housing. The heat is brought into the compartments through delta or twin pipelines or thick-walled 1.5 to 2 inch pipes. The heat distribution is achieved via normal heat regulation systems. Gas cannons can be used for rapid warming-up of compartments, e.g., before housing a new batch.

Cattle production: simple, cost-effective solutions

Simple, cost-effective building systems have established themselves in cattle production. Built are mainly large-volume buildings with eaves-ridge ventilation and simple wall cladding or lying houses with at least one open side. For the buildings with simple wall cladding, the established system for exhaust air leaving the building is through completely open roof ridge gaps or through large-area covered ridge gaps which are, however, not adjustable. The large-area coverings offers the advantage of optimum daylight being let into the building. Exterior air comes into the building through spaceboard, windbreak netting, adjustable roller blinds over open airways or baffle plates. Important points for ensuring good house ventilation include positioning with regard to the prevailing wind, the house width, and the roof pitch. Roof pitch should not be under 20°. Free air volume per cow should be around 35 m^3, which means an eaves height of at least 3.5 m. Where open-front buildings are more than 10 m deep the closed side should consist of air inlet systems such as spaceboarding, windbreak netting, adjustable roller blinds or similar, so that complete air exchange is possible. In housing which has one or more open sides and has proved suitable for rearing calves and young cattle, windbreak netting often offers shelter. The open sides should face south-east. Calves can also be reared in calf huts or igloos.

Outlook

In the future, the use of process computers in the many ventilation-controlling systems will increase further. Continual control is important, possibly through linkage with a PC. Cost-effective, directly controlled fans have proved themselves.

Additionally, the application of energy-saving measures (including of diffusers, use of moulded sections, or the rounding the corners of the inlet and exhaust air ducting, optimal matching of exhaust elements to fans) offers cost savings in the mechanical air extraction. In poultry meat production, the trend to cross-ventilated housing with free ventilation continues. With cattle production, the trend moves further to simple, non-insulated, large-volume buildings in the form of naturally-ventilated or open-sided houses. Adjustment of air inlet in non-insulated naturally-ventilated housing increasingly is done via adjustable roller blinds.

Because of the price development in primary energy costs, future heating systems will increasingly be expected to win heat back from expelled waste air through heat exchangers, or to make use of alternative or regenerative energies (for heating of livestock or domestic housing as well as of water systems).