Ventilation Project Report

May 2014
This report summarises the key findings from the ventilation project, with case study examples of the improvement opportunities identified.

Executive Summary

The BPEX Pig Health Improvement project (PHIP) aims to support all English pig producers to improve the health of the national pig herd by increasing knowledge and communication of relevant issues. Facilitating improved ventilation is of major benefit to the efficiency and productivity of the industry.

Farms participating in the PHIP project were offered the opportunity to access a free on-farm ventilation assessment delivered by a specialist contractor. The technical advice was shared with the farm veterinary surgeon and the farmer and presented at their local action-focused discussion group (cluster).

The visits highlighted issues such as:

- Incorrectly sized and positioned fans and air inlets
- Draughts
- Poor and damaged insulation
- Impact of adjacent buildings and internal fixtures and fittings on airflow
- Incorrect settings of controllers
- Poor maintenance and operator practice.

To determine how effective the individual ventilation visits and corresponding cluster meetings had been, BPEX conducted a questionnaire to gauge farmers’ opinions on what they had learnt. The following points were noted:

- All farmers surveyed found the meetings very beneficial, as they felt that they had initially received very little information on how their ventilation system actually worked
- As a direct result of attending one meeting, three farmers made changes based on the suggestions made. In addition, a number of farmers said that they might consider implementing some of the changes if they had the financial capacity to do so
- One farmer who altered the pig’s lying area and speed of air movement reported that the pigs were lying more comfortably in the pen as a result
- Another farmer moved the panels laid out to form a lying area from the centre of the pen, where the cold air was dropping and stressing the pigs, to the outer walls
- A third farmer altered the ventilation in his weaner building. Originally, both front and back flaps opened at the same time. The ventilation was improved by shutting the back flaps so air could only enter through the front flap, similar to a monopitch house. The canopies at the back of the building were extended to run across the back and down one of the side walls so that the pigs had sufficient lying area protected from falling cold air. Water drinkers were repositioned from the back of the pen to the front where the cold air drops, better suiting natural pig behaviour. While it is only early stages, the farmer has seen no difference in growth performance but has seen a reduction in mortality.

This project has implemented a unique combination of knowledge generation and business support, which has led to increased interest in ventilation from producers, veterinary surgeons and allied industries, with corresponding positive impacts for individual producers.
Introduction

Effective ventilation systems are essential for providing an optimum environment for pigs to live in and for people to work in. The consequences of a poor ventilation system will not only have an effect on the health and performance of the animal, its effects will carry over after the pig has left the building. This is because the pens can be dirtier and harder to clean, increasing the likelihood of disease-causing organisms building up in them.

The increasingly unpredictable nature of our weather, where seasonality is becoming less clear and increasing changes in temperature, wind speed and humidity over short periods of time are putting pressure on ventilation systems. Therefore, to maintain the right climatic zone we need to ensure that ventilation systems are correctly managed and operated. The climatic zone within the pen will influence the behavioural pattern of the animal, particularly with regard to lying and dunging areas. As pigs are very susceptible to draughts, if the climatic zone within the pen is not right, it will have serious implications for performance and the health and welfare of the pig.

There are many different ventilation systems in operation within UK pig buildings. These range from uncontrolled natural systems to fully automatic computer controlled systems which are capable of changing temperature, humidity, carbon dioxide and airflow. However, they all serve one purpose: to draw fresh air into a building and remove stale air containing dust, microbes, harmful gases and water vapour.

In 2012, BPEX contracted the services of an independent ventilation specialist to conduct twenty five on-farm ventilation visits. The objective of the project was to educate producers on the operation of ventilation systems with the ultimate aim of delivering better pig health and welfare, leading to improved performance.

A follow-up report was produced for each farm visited which focused on how the ventilation system could be improved. Each producer then had the opportunity to discuss the findings at their local cluster meeting. This led to discussions about general ventilation issues and the effects on production efficiency and health and welfare of the animals.
Case Study 1

Farm 1 is a 250 breeder-finisher unit. The main focus of the ventilation visit was on two buildings where tail biting was an issue from time to time.

Building 1

- A recently constructed, timber framed, fully insulated building
- 350 pigs per room, split into four pens which were arranged with two pens each side of the passage (Photo 1)
- Pigs were kept in this room from 7kg up to 40kg
- Tail biting increased as the pigs got older, particularly with pigs in pens at the back of the building
- The ventilation was computer controlled, with inlets in the side walls and two fans fitted into square wooden chimneys, with backdraught shutters on the top in the centre of the room (Photo 2)
- The room is controlled by a Dicam unit
- There are two manually adjusted radiant gas heaters in the middle of the room over the pen division to provide heat to both pens
- The pigs were provided with removable, plastic, solid flooring sheets as a lying area underneath these heaters.

Findings

There were two main issues with the ventilation system and design of the house:

Firstly, the north facing outer wall is exposed to the prevailing wind, resulting in cold air blowing in through the inlets on this side of the building, even when inlets are nearly closed, at minimum ventilation rates.

The ventilation system was working correctly, drawing air from the inlets across the ceiling and dropping in the middle of the room. However, the cold air was falling on top of the plastic flooring sheets intended as the lying area. It was suggested that the plastic flooring sheets should be repositioned against the outer wall, beneath the air inlets. Additionally, the gas heaters should be repositioned above the plastic flooring sheets to ensure the pigs lie in the correct area at all times during the growth cycle.

Secondly, there was no adjustable flap within the fan chimneys to control the airflow up through them. At low ventilation rates there was therefore, no ability to control airflow; consequently, ventilation rates were higher than intended as natural air currents took over.

As a result, pigs were becoming chilled and the energy used for heating was higher than necessary.
Recommendations

It was suggested that the square wooden chimneys should be replaced with two 560mm diameter fans fitted into a circular chimney shaft with automatic, adjustable flaps below the fan. These automatic flaps need to be controlled in conjunction with the speed of the fan so that when the fan is off or running at minimum ventilation rates, the baffle would need to be at the minimum opening position to prevent overventilation. Ideally, the winch motor for the inlets and the fans should be controlled by the same computer to allow for adjustment of the inlets according to the fan speed.

Outcomes

• This is a costly exercise which has not yet been implemented but the intention is to change the fans in the future to provide a better degree of ventilation control and heat management
• Since the visit, the building manufacturer has returned to cover over the inlets on the outside wall on the exposed side of the building (Photo 3)
• Instead of the wind and air hitting the vent and jetting through the house as it previously did, it now has to be sucked underneath this cover by the fans to enter
• Since the covers have been fitted, tail biting in the houses has stopped.

Other issues

After weaning, the pigs lie on the plastic flooring under the heater. Once the heaters are turned off and the sheets are removed, the pigs revert to lying beneath the inlets and dunging where the cold air drops, so the building is functioning as intended (Photos 4 and 5).
Building 2

- Monopitch timber construction with the front of the building being 3.0m high and the back 1.5m high
- There are four rooms in the house with 60 pigs per room split up into two pens
- The room is naturally ventilated with a pivoted 900mm high flap the full width of the front of the building with same size vents at the back
- The feeders are positioned in the middle of each room and the drinkers placed between feeders and the rear wall (Photo 7).

Findings

The cause of the ventilation problem in this building is that the rear and front flaps open at the same time through the use of a linear actuator.

As the front vent is being adjusted by the computer controlled actuator, this also adjusts the rear vent through a rope and pulley system (Photo 8).
This type of ventilation system should work on a similar principle to a monopitch-type house. The warm air from the pigs will rise to the sloping ceiling and move to the highest point at the front vent and out the top of the inlet flap, with fresh air entering through the bottom of the inlet flap. However, due to the imprecise nature of natural ventilation, both the front and back vents will have air coming in and out depending on the prevailing wind, which results in the incoming cooler air dropping at both the front and back of the pen; this creates cold areas at both ends of the pens.

**Recommendations**

To overcome the problem of cold areas at both ends of the pens, the front and rear vents need to be adjusted separately. This can be done by fitting a separate actuator on the rear vent which can be controlled by the existing computer. The back ventilation flap needs to lag behind the front one, this can be achieved by setting the back flap to a temperature slightly higher than the front vent (e.g., front vent set at 20°C with the rear vent set at 23°C). The back vent should only start to open when the front vent is at 100% opening or at maximum ventilation rate, this will encourage the pigs to use the back of the pen as the lying area.

The drinkers will need to be repositioned from the back of the pen to the front so as not to interfere with the pigs’ lying pattern.

**Outcomes**

- The changes have been made at very little cost, taking two people one day to do the necessary work
- The existing Dicam controller is being used to control both ventilation flaps and the temperature in the house
- Two temperature sensors have been installed in the house, one at the front and one at the back. The back vents are run at 3°C higher than the set temperature of 20°C at the front
- Instead of running the houses as four separate houses, they now run as one house
- The producer has found that the changes have worked well, with the pigs lying better in the pen (Photo 9). Tail biting has also stopped since the changes have been made, resulting in fewer condemnations of slaughter pigs at the abattoir.
Case Study 2

Farm 2 is a 270 breeder-finisher unit. The main focus of the visit was on the farrowing houses and grower house where there were tail biting problems.

Farrowing house

The farrowing house is an old building with a pair of wall-mounted ACNV flaps (1m x 0.4m) and a pair of similar sized manually controlled flaps on the opposite side. These side-to-side ventilation flaps work fairly well when it is windy, however, in warm, still conditions there is little airflow, making the room stuffy and hot.

Recommendations

- To fit a new 400mm diameter fan in a new circular shaft in the centre of the building
- In addition, a rotating flap should be fitted within the chimney below the fan which would reduce the opening as the fan slows down, preventing warm air escaping up the chimney so the temperature of the building is maintained. In warm weather, the flap opens as the fan speed increases, allowing an unimpeded flow of exhaust air to keep the building cool
- The existing inlets should be replaced by automatic inlets (two or three in each side wall of the room) controlled in conjunction with fan speed, which open and close proportionally.

Outcomes

This recommendation has not yet been implemented due to the age of the building and the cost.

Other issues

Prior to the visit, two rooms were fitted with thermostatically controlled fans, the controlled inlets were linked to this, the manual ones providing additional override.

Recommendations

- It was recommended that the existing fan be moved closer to the door in the outer wall, as close to the ceiling as possible
- The manual inlets should be closed up and sealed, while using the existing automatic inlets to open and close according to the room temperature, with the fan running constantly on a variable speed controller. This would allow the fan to run at a minimum speed at all times and speed up automatically as the temperature rises.

Outcomes

The above recommendations have been implemented, which has helped to create a fresher atmosphere in the room.
Other issues
There was also a problem in a proprietary grower house where pigs were becoming stressed as they got older, leading to tail biting. The solution to this was to have the front and rear vents opening separately rather than together, as was currently happening. This recommendation has been implemented, with the first batch of pigs having gone through.

Outcomes
• No tail biting has been seen since the vent opening was adjusted. However, during this period the weather was quite cold with no hot days. It will be interesting to see if there is any increase in tail biting during the summer months
• In addition, kennels/canopies have been fitted to the existing sow house to prevent cold air falling on the sows’ lying area. This has resulted in a warmer lying area for the sows, particularly during cold weather
• The producer found the visit very interesting and it has got him thinking more about how the system works and how cold air affects the pigs.
Case Study 3

Farm 3 is a 1,400 breeder-finisher sow unit, with buildings ranging from construction in the 1970s up to the present day. The main focus of the ventilation visit was on the farrowing houses, where scour problems have been noted and the new proprietary weaner house, where tail biting has occurred in certain pens.

Building 1

The farrowing houses where scour was occurring are timber framed houses, with 40 sows and progeny per room. There are five 400mm diameter fans with hand-operated inlets in the outer walls. These inlets were badly fitted with gaps exposed when the vents were fully closed, creating draughts.

Findings

An unusual feature in these houses was that the heat pads were controlled by the room temperature. A smoke test carried out on the system indicated that when the fans were running at minimum fan speed, the incoming cold air dropped into the front feed passage. However, when the fans ran at maximum speed, this incoming cold air fell into the farrowing pens and onto the piglets’ creep area.
When the heat pads were on, the warmth would have displaced some of the cold air that was falling in this area. However, when the pads were turned off, particularly as the piglets got older, there was no warm air from the pads to displace the cold air, causing stress to the piglets which resulted in scour.

Recommendations

• To prevent cold air falling on the piglets, it was suggested that the creep areas should be covered, with the lids angled upwards to prevent any air that may fall on the covers from dropping into the pen
• The temperature of the heat pads needs to be better controlled to encourage the piglets to lie on them, this can be achieved by using a pad with an integral thermostatic switch linked to the controller
• The fans need to be better controlled to allow for a gentle increase from minimum to maximum speed rather than the current rapid rise, to prevent stray draughts.

Outcomes

This work has not yet been completed as the farmer has been unable to source any baffles.

Building 2

• The other building where problems were occurring, particularly with tailing biting as the pigs got older, was a new, wooden framed, fully insulated, pitched roof building
• The building contains six rooms with eight pens per room
• There is a central passageway with four pens each side running perpendicular to the ridge in the roof
• The ventilation system is fully automatic computer controlled
• There are two 630mm diameter extraction fans in the ridge with inlets in the outer walls.

Findings

The problem with this house is that the pen design is incompatible to the ventilation system. A smoke test showed that incoming air flowed up the ceiling and fell to the floor in the two middle pens.

Recommendations

• It was suggested that instead of having eight pens per room there should be four, two either side of the central passage. This would allow the pigs to lie under the inlets in the outer wall where the room is warmer and dung in the middle where the room is colder
• It was also suggested that the gas heater used to heat each room should be controlled by the computer to prevent it from providing heat when not required or, worse still, not providing heat when required.

Outcomes

• Since the recommendations were implemented, tail biting has stopped and the lying pattern of the pigs has changed, they now look a lot more comfortable and are performing better physically
• The manager found the ventilation visit very useful and is seeing the direct benefits. He now has a better understanding of ventilation requirements and is able to apply this across the site.
Case Study 4
Farm 4 is a 550 breeder-finisher unit with a range of buildings that have been constructed over the past thirty years.

Building and findings
The main issue on this unit is pleurisy in an ACNV finishing house that was constructed over 25 years ago. The building is naturally ventilated and works on the principle of side-to-side ventilation. However, for this ventilation system to work, it requires a minimum wind speed of at least one mile per hour. In addition, the building contains a high level of dust due to the lack of a ridge outlet. The dust could be contributing to the pleurisy problem. Due to the size of the building, it is not practical to fit a large enough ridge in the existing building.

Recommendations
It was suggested that a fan system should be installed along the length of the building which will extract the warm dust-laden air.

The intention is that the house will work like a naturally ventilated system as normal. However, when the room gets too warm, the baffle on the end of the fan will open to let out the warm air. If this is still not adequate, ventilation to reduce the temperature will be used and the house will work like an automatic negative pressure fan controlled house until the desired temperature is reached, when it will then return to a natural ventilation system.

Outcomes
This is quite a costly operation to implement and, given the age of the houses, it was not considered worthwhile. However, the producer will consider this type of ventilation system when he is in a position to upgrade his buildings.
Case Study 5
Farm 5 is a breeder-finisher unit that was having tail biting problems in both a weaner and finisher house.

Building
The weaner house is a wooden framed insulated pitched roof building. It has a negative pressure ventilation system consisting of a fan chimney in the ridge and inlets in the outer walls. The chimney draws the air out of the building through the ridge while directing the incoming air from the inlets across the ceiling to drop in the middle of the room.

Findings
While the ventilation system operates correctly, there is an insulated concrete pad in the middle of the room, which acts as the lying area for the pigs. The problem is that this is where the cold air falls. This is not an issue when the pads are warm as the rising hot air will deflect the cold air from falling on the pigs. However, when the pads are off and there is no hot air rising from the pads, the cold air falls in this area. This causes significant stress for the pigs, resulting in tail biting and pigs dunging on the concrete area.

In addition, the lying area for this type of system is against the outer walls but this is where the feeder and water nipples are placed, which makes it an unattractive lying area for the pigs. Since the concrete heat pads cannot be moved to the outer wall, a system has to be designed to redirect the incoming cold air to fall against the outer wall.

Recommendations
It was suggested that a curved cowl is fitted to the inlets to direct the air down against the outer wall.

Building 2
The same issue can be found in the straw-based finishing house, where the incoming cold air falls on the straw bedded lying area, stressing the pigs. This house has a negative pressure ventilation system with a lying and feeding area in the middle of the pen, with two dunging passageways on either side against the outer walls (Photos 20 and 21).

Findings
When the pigs enter the house at 40kg, they are able to avoid the area where the cold air is falling, by lying on the outer edges of the straw bedded area. However, as the pigs get older they require more space, resulting in them having to lie in the path of the incoming cold air.
Recommendations
The incoming cold air has to be deflected to the outer walls. It was suggested that a curved cowl similar to the one suggested for the weaner house is used to deflect the incoming cold air away from the straw bedded lying area.

Outcomes for both houses
Business reorganisation and reconstruction of buildings means work has not yet started to remediate these buildings. In the interim, lower stocking rates and cooler ambient temperatures have resulted in fewer problems. Improvements are scheduled for the near future.

Overall conclusion
This unique combination of knowledge generation and business support from the on-farm ventilation assessments, such as reduced incidence of vice and increased conception rates, has led to positive impacts for individual producers. In addition, there is now a greater awareness among producers, veterinary surgeons and allied industries of the relevant issues and their potential solutions.

The results are being used to develop a BPEX Ventilation Best Practice Guide, which will be disseminated to producers in England. BPEX will continue to offer support on ventilation and also thermal management for efficient production.
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