Carbon Dioxide Stunning and Killing of Pigs

SUMMARY

Increasingly, in larger plants in the UK and elsewhere, carbon dioxide is being used for the stunning and killing of pigs. For large operations with high throughput rates (eg 800 per hour), this is often the most reliable slaughter method for ensuring consistency in terms of good welfare and quality. Although the inhalation of carbon dioxide is aversive, overall controlled atmosphere stunning may have some welfare advantages.

For the system to be as humane as possible, it is essential that animals are exposed to the maximum concentration of carbon dioxide as soon as possible and that the dwell time is sufficient to ensure that animals do not regain consciousness before death.

All operators shackling and bleeding pigs should be capable of checking for, and recognising, signs of both effective and ineffective stunning. They must know what to do if signs of recovery are seen.

Legislation

The legislation covering the welfare of all farmed animals within the UK, during the handling and slaughter process is *The Welfare of Animals (Slaughter or Killing) Regulations 1995* (as amended) (WASK '95). In Schedule 7, this requires that the chamber used to stun/kill pigs is fitted with devices which—

4 a (iv) enable the pigs to see each other as they are conveyed in the chamber; and

(v) once a pig enters the chamber, it is conveyed to the point in the chamber of maximum concentration of the gas mixture within a maxiumum period of 30 seconds;

In addition the design and operation of the chamber must ensure:

4 b there is a means of visually monitoring pigs which are in the chamber;

c adequate lighting is provided in the conveying mechanism and the chamber to allow pigs to see other pigs or their surroundings;

4e (i) measure the concentration by volume of carbon dioxide in the gas mix at the point of maximum exposure;

(ii) .. continuously display the concentration by volume of carbon dioxide as a percentage of the gas mixture at the point of maximum concentration in the chamber; and

(iii) give clearly visible and audible warning signals if the concentration by volume of carbon dioxide falls below 70%;

Finally and one of the most important points:

5 a each pig is exposed to the gas mixture for long enough to ensure that it is killed.

Physiology

It is well documented that some species of animals find high concentrations of carbon dioxide aversive and will try to avoid exposure to these. In the case of gas killing using carbon dioxide, pigs are seen to exhibit strong reactions for a period of up to 30 seconds. However, recent research has shown that some of this is reflex movement after the animal has lost consciousness and is therefore not a welfare concern.

As with many gas killing systems, carbon dioxide partly acts by displacing oxygen so the brain cannot function and brain death ensues. However, carbon dioxide also has a direct anaesthetic effect which results in loss of consciousness more quickly than with some other low oxygen gas mixtures such as argon and nitrogen mixtures.

Why gas?

As mentioned above, carbon dioxide is aversive to animals and exposure to high concentrations compromises welfare. However, this system has many welfare benefits including: reduced risk of potential human error compared with, for example, electrical stunning in which there is a risk of incorrect placement of electrodes; animals remain in groups; consistency and effectiveness at high throughputs. Whilst an alternative non-aversive gas mixture would be preferable, no such alternatives are currently commercially available.

Types of machine

A number of systems are available which cater for different throughputs and budgets, and these differ in welfare advantages and disadvantages.

Single-entry systems can require excessive force and coercion to get the pigs to load, resulting in regular use of handling aids in order to meet the demands of the production line.

Some older systems do not always provide a high gas concentration at the first stop. This means pigs will be exposed to gas at levels which will cause discomfort, but not rapid unconsciousness.

For these reasons, and to comply with best practice in terms of animal welfare, only new group-loading systems which drop into a high level of carbon dioxide at the first stage should be considered.

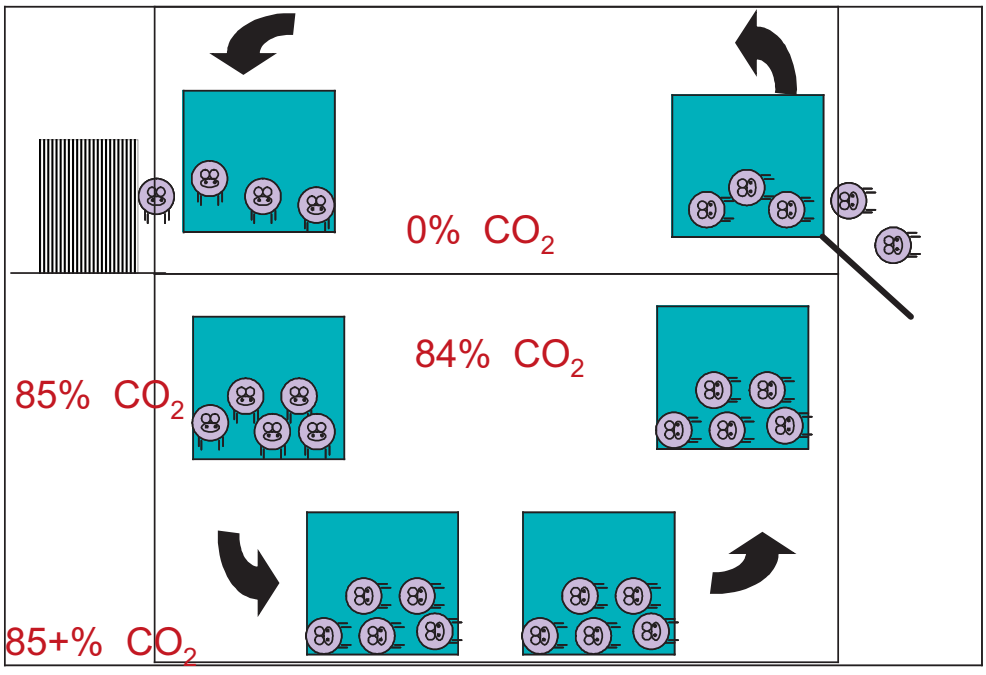

Figure 1 - Example of side-entry carbon dioxide stunning machine

Newer systems use a series of automatic gates, with pressure sensors to prevent crushing, to move the pigs forward and then load them into the gas system. This avoids the need for handling by staff and also the need for handling aids. As can be seen in Figure 1, the gas machine consists of a number of gondolas which rotate down into a chamber and then rotate up to the top to release the stunned/killed animals.

Time to maximum concentration and dwell time

Once in a gondola the animals are lowered into the chamber. Since carbon dioxide is heavier than air, the maximum concentration is at the bottom. However, the gas should be of a suitable concentration to take effect on the animals as soon as they are lowered into it. This is required because of the stop/start nature of the system, as pigs may be held in a position above the maximum gas concentration until the system rotates again, lowering them into a minimum level of 85% carbon dioxide.

It is a legal requirement that no more than 30 seconds must elapse after a pig has entered the chamber before it is in a gas concentration of 85% or more. With most systems there will be at least one stop before the animals reach maximum concentration, which means that each part of the cycle should be no more than 25 seconds.

UK law requires that pigs are not removed from the system until they are dead or irrecoverably stunned.

To ensure that animals cannot return to consciousness, a dwell time of two and half minutes is required. It is important that pigs show no corneal reflex after exiting the system.

If pigs do not have a sufficient dwell time they will start to recover when they exit the machine, with the risk that they may be bled whilst conscious.

New systems allow password protection on settings, so that only a supervisor can alter the duration of the cycle times. This is important to avoid the machine being accelerated by staff to cope with surges in demand which would compromise welfare.

Monitoring systems

As noted above, it is a legal requirement to have clearly visible and audible alarms to monitor the gas concentration. However, these should always be supplemented by careful observation of the animals.

Staff working with these systems should be able to recognise both an effective and ineffective stun/kill and know how to react to them. Means of assessing effectiveness should be both simple to perform and understand. They need to be done by staff working in the area and carried out regularly throughout the shift. Both visual and physical assessment (see below) should take place, with the visual checks occuring continually and the physical tests done regularly on a random basis throughout the day. The results of these tests should be recorded so that any changes in effectiveness can be monitored and any slight changes picked up quickly, before a problem arises. Animals should show no reaction to any of the tests below:

Assessment	Test	Notes
Visual	No rhythmic breathing	Agonal breathing may be seen. This is random gasping and is not a sign of a return to consciousness.
Visual	Recumbency	The animal carcase should be relaxed, with the jaw open and tongue may be hanging out.
Visual	No voluntary movements	An unconscious or dead animal can still display random or uncordinated movements. These should not be confused with co ordinated movement.
Physical	Pin prick	A pin prick in the nose should not produce a reaction - if there is a reaction, there is a possibility that the animal is recovering.
Physical	Ear pinch	Like the pin prick this should not produce a reaction.
Physical	Corneal reflex	Touching the eye should result in no corneal reflex. Presence of a corneal reflex suggests the system is not working effectively.

Monitoring the system

Both the operating staff and equipment should be monitored regularly to ensure effective and efficient performance. All staff should be trained in the use of the equipment and understand its operation. In particular they should be aware of:

- average cycle times
- signs of consciousness and unconsciousness when animals exit the chamber
- what they should do in an emergency
- the correct gas concentration
- where the gas concentration is measured in the system
- procedures for mixing the gas after extended breaks

Daily monitoring should include: (visual and physical) tests that animals are consistently rendered unconscious and recording of gas concentrations. This should be done by slaughter staff throughout the day and technical staff at least once a day. More in-depth monitoring should include all of the assessments mentioned above, be structured and recorded in detail and ideally carried out by somebody not working with equipment on a daily basis. Findings relevant to welfare should be incorporated into action plans for improvement where necessary.

Parameters of a good system

A good system, working effectively, will have:

- a regular cycle
- side, group entry which requires minimal handling
- a system to ensure pigs enter the gondola only when ready to be dropped
- sufficient lighting for animals to see, but not too bright
- rapid exposure of pigs to high levels of carbon dioxide
- sufficient dwell time to ensure adequate stunning/killing
- a regular rotation of staff
- signs of recovery regularly checked
- a back-up stunning system available at exit and sticking
- feedback from shacklers to loaders
- a contingency plan in place for factory breakdown, fire alarms, etc to remove and immediately kill animals in system
- clear details of the alarm system on display, in addition to contingency plans etc.

Further reading

The Welfare of Animals (Slaughter or Killing) Regulations 1995 (as amended) HMSO 1995

Regulation (EC) No. 853/2004 - 'H2' HMSO 2006

Full details of all legislation can be found on www.legislation.hmso.gov.uk

Electrical Stunning of Red Meat Animals HSA 2005

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