November 2022

Gas Killing Systems for Farmed Chickens and Turkeys

Key Advantages

The use of gas systems for the killing of poultry has become increasingly popular in the UK over recent years. The Food Standards Agency's 2022 Animal Welfare Survey reported that gas killing accounted for 80% of poultry throughput in England and Wales[1]. The use of gas systems varies across the European Union, but it is estimated that 20% of broiler chickens, 7% of laying hens and 24% of turkeys in the EU are now slaughtered using this method[2]. These systems are replacing use of electrical water-bath stunning systems and are generally viewed as a more humane alternative.

In comparison to water-bath stunning, one major welfare advantage of gas killing is that the physical handling of birds at the slaughterhouse can be completely eliminated. In most cases, the bird transport containers can be automatically loaded directly into the gas system without having to remove the birds first. In electrical water-bath systems, however, the birds have to be manually removed from their transport crates individually and are inverted and hung by their legs on a metal shackle, which conveys them to the water-bath. This is both painful and stressful to the birds.

There are also other significant welfare benefits associated with gas killing systems. For example, compared to electrical water-bath systems, they can offer a more consistent and reliable induction to unconsciousness and, in the UK, it is a legal requirement that the birds must be killed in the system rather than just stunned.

However, unlike some other methods of stunning poultry, gas systems do not instantaneously render poultry unconscious and insensible to pain and distress. It is therefore of high importance that these systems are designed, operated and managed appropriately to ensure the most humane kill possible is achieved.

Gases Used

There are various designs of gas killing systems available globally, which have been designed to be used with different gases or gas mixtures: some use carbon dioxide gas only; some use inert gases, such as argon; and others use a mixture of the two - inert gases and CO_2. Further, most systems have been designed to expose birds to one or more 'stages' or 'steps, whereby each stage/step contains a different concentration of the gas being used: starting at a low concentration and increasing to a higher concentration.

Birds are killed (or rendered irreversibly stunned) in the system due to a reduction in the levels of oxygen in the chamber as the concentration of gas(es) increases. This results in unconsciousness and then the subsequent death of the birds. Depending on the system used, the gas selected, and the concentration of the gas, then this process can rapidly and humanely render the birds unconscious and insensible to pain and distress.

CARBON DIOXIDE (CO_2)

CO_2 is a relatively inexpensive gas. It has an anaesthetic effect on birds and therefore can result in a calmer induction to unconsciousness. CO_2 is also heavier than air, making it easier to 'manage', and this attribute has been usefully exploited in the design of some gas killing systems. However, the major disadvantage of CO_2 is that it is aversive to chickens and turkeys, with the degree of aversion increasing as the concentration rises: for instance, chickens can start to detect the presence of CO_2 at around 7%; and at 25%, some aversion may be observed.

Gas killing systems for farmed chickens and turkeys

At concentrations of 40% and above, CO_2 is considered to be particularly aversive. For this reason, it is important that the birds are initially exposed to a low concentration of carbon dioxide – up to 30% - until they have lost consciousness. Once the birds are unconscious they can be exposed to higher concentrations of the gas until death occurs. Within the European Union, it is a legal requirement that birds have lost consciousness prior to exposure to concentrations above 40% CO_2.

INERT GASES

Inert gas mixtures, such as nitrogen or argon, are relatively more expensive gases. However, birds are unable to detect the presence of these gases and, as such, they are not aversive. These gases can be more challenging to 'manage' as, for example, nitrogen is lighter than air, making it more difficult to contain. To be effective, the gas within the system must be maintained at a level that reduces the available oxygen to below 2%. This can be technically difficult to achieve and maintain in some systems. Although inert gases do not result in aversive behaviour, there still remains some concern around their use. This is because, after loss of consciousness, birds can perform quite vigorous, uncontrolled wing flapping and body convulsions, which can affect those birds that have not yet lost consciousness. However, despite having the potential to cause some discomfort in this respect, this is likely to be an issue for a short duration only.

INERT GAS WITH CARBON DIOXIDE (CO_2)

Inert gases mixed with CO_2 may also be used, e.g. argon and CO_2. Within the European Union it is a legal requirement that the level of carbon dioxide in such mixtures does not exceed 40%, and in the United Kingdom it must legally be no more than 30%. To be effective, the gas mixture within the system must be maintained at a level that reduces the available oxygen to below 2%.

Systems currently in use

There are three main types of gas systems: tunnels, pits and closed cabinets. In most systems, the birds remain in their transport crates throughout the killing process. This is considered desirable from a welfare perspective, as it reduces the stressful handling of birds. However, some systems automatically empty the birds from their crates, which causes unnecessary stress.

In tunnels and pits, the systems are pre-filled with gas and the birds enter continuously at one end of the system and are conveyed to the opposite end where they exit. In contrast, in closed cabinet designs, birds are loaded into the system as one 'batch' and remain static within the system. Only once the birds have been loaded within the system is the gas then added. Then, when the birds are dead and the process ends, the gas is fully evacuated, the birds are unloaded, and the subsequent 'batch' of birds loaded. The fully enclosed design of the cabinet systems offers a greater level of control and uniformity over the gas killing process.

There are currently four main manufacturers of large-scale, commercial gas killing systems globally: Meyn, Marel Stork, Linco and Anglia Autoflow. The typical operation of the systems they manufacture is described below. However, various factors, such as gas concentrations and dwell times, can be adjusted according to the requirements of the factory where the system has been installed.

MEYN

Meyn manufacture a gas killing system of the closed cabinet design. The birds remain in their transport module throughout the killing process, i.e. the individual transport crates that sit within a module are not removed. Once the module enters the system, CO_2 is introduced in 'stages', with the concentration gradually increasing with each stage. There are five stages in total, which last a total of six minutes: each stage lasts for one minute, except for the final stage which continues for two minutes. These stages take place within two virtual phases: four stages below 40% CO_2 (Phase 1) and one stage above 60% CO_2 (Phase 2). Induction to unconsciousness occurs during phase 1, after the first two stages. A proportion of the birds can be monitored throughout the process via a window at the rear of the system.

Gas killing systems for farmed chickens and turkeys

MAREL STORK

Marel Stork manufacture two different designs of CO_2 gas killing systems: a bi-phasic (two phase) system and a multi-phase system. Both systems are of the tunnel type.

With regards to the bi-phasic system, birds are automatically emptied from their transport crates and transferred to, and through, the system via a number of successive, adjoining conveyer belts. In phase one, birds are exposed to CO_2 up to a concentration of 40% for a period long enough to render them unconscious. They then continue into the second phase, whereby the concentration of CO_2 exceeds 40% and the birds are killed. The phase one and phase two tunnels are physically joined to form a continuous tunnel, but the second phase tunnel is positioned beneath that of the first phase tunnel. Because CO_2 is heavier than air, this design helps maintain the correct concentration of CO_2 within the two tunnels (phases), i.e. it helps to prevent gas moving from a greater concentration in phase two, positioned below, to the lower concentration in phase one, positioned above. Further, the entrance to phase two has a plastic curtain to help contain the gas.

Marel's multi-phase system is designed as one long tunnel which, unlike the bi-phasic system, is on one level. The tunnel is physically divided internally into five sections (stages) by the installation of plastic curtains. Birds are transported through the system whilst remaining in their transport crates. Each stage exposes the birds to an increasing concentration of CO_2 - starting from c.28% (first stage), rising to above 70% (final stage). During the first three stages, oxygen can be added to the CO_2 mix, which is reported to result in a smoother induction to unconsciousness. The total time the birds spend in the system is set to five minutes, whereby birds are exposed to each stage for one minute, but this can be adjusted.

In both systems, birds can be observed as they are conveyed through the tunnels via windows positioned along the sides.

LINCO

Linco manufacture a pit-type system. Here, the birds enter the system within their transport crates. On entering the system, the birds descend to the bottom of the pit in 'stages'. At each 'stage', the crate stops for a set period of time to expose the birds to a gradually increasing concentration of CO_2. The gas concentration gradient in the pit ranges from about 5% at the top of the pit to greater than 70% near the bottom. The number of stages the birds are exposed to varies according to bird weight, with heavier birds being exposed to more stages to maintain a constant dwell time and throughput rate. The minimum desired dwell time is six minutes. Birds can be monitored within the system via a remote controlled infra-red camera that can be moved up and down the pit to monitor the birds at different stages, or follow a group of birds within a crate as they descend. A CO_2 sensor is mounted on the camera enabling the concentration to be monitored at different stages too.

ANGLIA AUTOFLOW

Anglia Autoflow manufacture two different designs of CO_2 gas killing systems: a bi-phasic (two phase) system and a multi-phase system. Both systems are of the tunnel type, and birds are transported through both whilst remaining in their transport crates.

In the bi-phasic system, in phase one, birds are exposed to CO_2 up to a concentration of 40% for a period long enough to render them unconscious. They then continue into the second phase, whereby the concentration of CO_2 exceeds 40% and the birds are killed. The phase one and phase two tunnels are physically joined to form one tunnel, but the phase two tunnel is positioned beneath that of phase one. Because CO_2 is heavier than air, this arrangement helps maintain the correct concentration of CO_2 within the two tunnels (phases), i.e. it helps prevent gas moving from the greater concentration in phase two, positioned below, to the lower concentration in phase one, positioned above.

Anglia Autoflow's multi-phase system can be designed as a long tunnel or, like the bi-phasic system, can be on two levels. The tunnel is physically divided internally into five sections (stages) by the installation of sliding doors.

Gas killing systems for farmed chickens and turkeys

Each stage exposes the birds to an increasing concentration of CO_2 – starting from c.25% (first stage), rising to above 50% (final stage). The total time the birds spend in the system is set to five minutes – whereby birds are exposed to each stage for one minute – but this can be adjusted.

Anglia Autoflow also manufacture a single-phase gas killing tunnel system that can be used to kill birds using inert gases only or inert gases mixed with CO_2.

In all systems, birds can be observed as they are conveyed through the tunnels via windows positioned along the sides.

Further resources

CIWF Food Business Resource: Humane Slaughter: Overview
https://www.compassioninfoodbusiness.com/media/7427576/humane-slaughter-summary.pdf

CIWF Food Business Resource: Humane Slaughter: Broiler Chickens
https://www.compassioninfoodbusiness.com/media/7427577/humane-slaughter-broiler-chickens.pdf

RSPCA welfare standards for meat chickens; laying hens; and turkeys: 'Gas killing' standards

https://science.rspca.org.uk/sciencegroup/farmanimals/standards/chickens

https://science.rspca.org.uk/sciencegroup/farmanimals/standards/layinghens

https://science.rspca.org.uk/sciencegroup/farmanimals/standards/turkeys

References

[1]Food Standards Agency (2020) Results of the 2022 FSA Slaughter Sector Survey in England and Wales

[2]European Commission (2013) Report from the Commission to the European Parliament and the Council on the various stunning methods for poultry. Available online: http://ec.europe.eu/food/sites/food/files/animals/docs/aw_practice_slaughter_com_2013_915_report_en.pdf Accessed: 01/12/2017

Royal Society for the Prevention of Cruelty to Animals
Wilberforce Way, Southwater, Horsham, West Sussex RH13 9RS
0300 1234 999 www.rspca.org.uk facebook.com/RSPCA twitter.com/RSPCA_official