



Transportation and pre-stun handling: CO₂-systems

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A new Danish concept is developed for pre-slaughter handling of pigs, where pigs are kept in the same groups during transport and at the abattoir, including stunning. This reduces pig stress, eliminates need for prods and improves meat quality.

Summary

CO₂-stunning has some advantages over electrical stunning in that the lining up process immediately before stunning is not strictly necessary. This has allowed the development of alternatives to shute systems that, combined with modifications to the CO₂-equipment, reduce pig stress, eliminate the need for prods and give certain improvements in meat quality. Noise levels are reduced to background levels, thus improving working environment.

This paper will describe the new Danish concept for pre-slaughter handling of pigs, where pigs are kept in the same groups during transport and at the abattoir, including stunning.

Introduction

The ideal pre-slaughter treatment should fulfil a number of requirements:

- It should be considerate (good welfare)
- It should give a good, uniform meat quality
- Transport and lairage mortality should be low
- Working environment should be good

Good welfare covers factors such as voluntary forward movement with a minimum of force, fulfilment of the pig's physical requirements, no damage, but in the event of damage prompt treatment of the affected animal.

In recent years it has been proposed that unfamiliar pigs should never be mixed pre-slaughter. By keeping unfamiliar pigs separate, fighting is eliminated, skin damage and bruising reduced and there are certain meat quality advantages such as less DFD-meat. Pig welfare is optimal in such a system. In practice, of course, this goal is unattainable. Pen sizes on farms vary, as do group sizes on transport trucks and in abattoir holding pens.

In Denmark special focus has been put on adapting plant design to pig behaviour, especially the treatment in abattoir holding pens and the movement of pigs from the holding pens to and through the stunning equipment. A concept has been developed that involves groupwise treatment of pigs both during transport and at the plant and includes the stunning itself. Mixing of unfamiliar animals is allowed at loading onto the transport truck but after this initial mixing pigs are kept in the same groups throughout. This concept has many welfare and quality advantages, while at the same time being practicable and will be described in more detail in the following. It eliminates the need for electric prods completely thus fulfilling another demand increasingly being made by retailers and consumers.

Transportation and holding pens

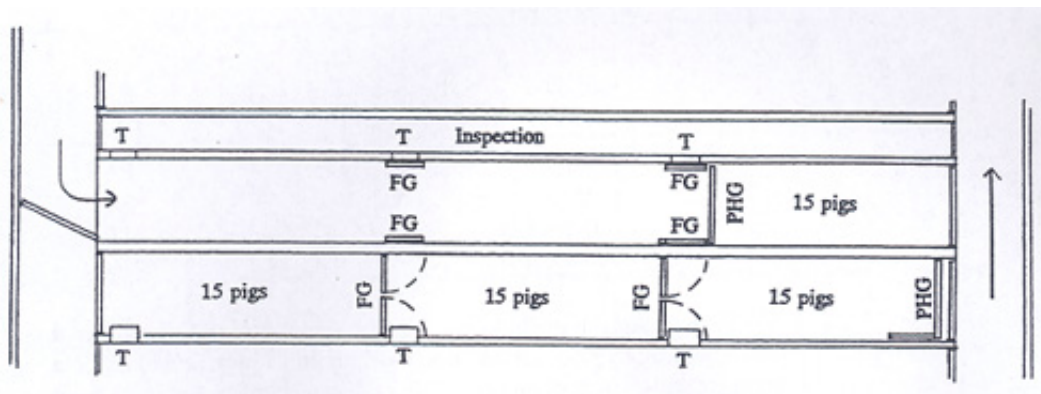
Modern Danish transport trucks are divided into compartments of 15 pigs and this was chosen as the group size in the concept. Pigs are loaded using a tailgate lift in Denmark, which takes 7-8 pigs, so that after two groups have been loaded, the internal gate can be closed. This gives support to the pigs and reduces damage during transport. Each group of 15 pigs is off-loaded separately, and with 15 pigs in a group all animals can be reached by a handler, making pig movement at off-loading and transfer to holding pens easier. With a properly designed system the only means of force necessary is a driving board. Danish pigs are not slap-marked or weighed live at the abattoir. Slap-marking is carried out by the farmer before collection, and payment is based on hot carcass weight and carcass lean meat content, so that live weights are not important.

Previously, holding pens took a whole truck load, ie. pigs were further mixed at the plant. One of the disadvantages with this system was that it was difficult for plant personnel to move pigs out of the lairage without force (prodders) being used and that fighting, which is caused by a few very aggressive animals, can involve many pigs. Another disadvantage is that the sizes of holding pens and transport trucks are not always compatible, which leads either to overstocking or mixing different loads in holding pens. The new concept

divides the holding pen into groups of 15 using a series of flap gates and one push-hoist gate per pen. On filling a pen string, all flap gates are retracted into the wall. 15 pigs are moved from the off-loading bay to the pen and the push-hoist gate, which is in the raised position at the entrance to the string, is activated. The gate

is lowered and moves behind the pigs until a point is reached that allows the flap gates (FG) to close. As these close, the push-hoist gate (PHG) is raised and moved back to collect the next 15 pigs and so on. As flap gates close, a trough is automatically lowered, or drinking nipples are available for watering the pigs. Emptying is the reverse of this procedure. Figure 1 shows a sketch of this system.

Figure 1



Filling the system is easy. Pigs move calmly and noise levels are equivalent to background levels. Fighting is almost eliminated, even though the pigs could have been unfamiliar to one another. The reason for the lack of aggression is not completely clear. It may be that a group of 15 is less threatening than larger groups, or it may be that the chance of finding an aggressive animal and a pig that will react to that aggression is less in small groups. Whatever the reason, less aggression leads to pigs lying down to rest more quickly, normally within 20-30 minutes as against 60-90 minutes for larger groups, and mortality in holding pens fell from above to below the national average at that time (from 0.05 to 0.01 %). Less aggression means less skin damage and this was also found for legs and shoulders in a comparison (Table 1).

Emptying the small pen system is also easy. The push-hoist gate moves over the heads of the resting pigs as the flap gates open, thus alerting them, so that many stand up and move along of their own free will. Correct lighting facilitates this movement. It should be mentioned that push-hoist gates are adjusted so that they stop at a counter pressure of 100 kg (one pig). In this way pigs can never be dragged by the gate.

Both filling and emptying pens are thus carried out without human intervention and with a minimum of force and is a major improvement in pig welfare. A fully automatic system has been running at a Danish factory, where pig movement out of the holding pen is carried out at a rate of 800 pigs per hour. At lower speeds fully automatic systems can be replaced by manually operated systems that retain the welfare level provided that design and utilisation is optimal.

Table 1: Incidence of unacceptable meat quality in relation to group size in the lairage

Description			Pen 2 (15 pigs)	Pen 4 (45 pigs)
% PSE	b. femoris	probe ³ 100	4.0	3.5
	l. dorsi	probe ³ 80	1.4	2.1
% DFD	b. femoris	pH _{ult} > 6.1	1.3	1.5
	l. dorsi	pH _{ult} > 6.1	2.5	2.7
	s. capitis	pH _{ult} > 6.3	8.3	9.2
% skin damage		leg	3.9	5.2
		middle	3.9	4.8
		shoulder	16.1	23.7

	l. dorsi	0.6	1.6
	b. femoris	0.0	0.0
	semimembr.	0.0	0.0
% blood splashing	quadriceps	0.0	0.0

The small pen system solves the problems in the holding pens but highlights the difficulties that remain in getting the pigs to and through the chute and into the stunning equipment. The final part of the concept involves the development of an automatic system to transfer the pigs from the holding pens to the stunning area and finally into the stunning equipment itself. The principle of the new concept is that 15 pigs are driven forward using a series of push-hoist gates or, alternatively, manually driven to the area in groups of 15. The concept is then comprised of three main elements:

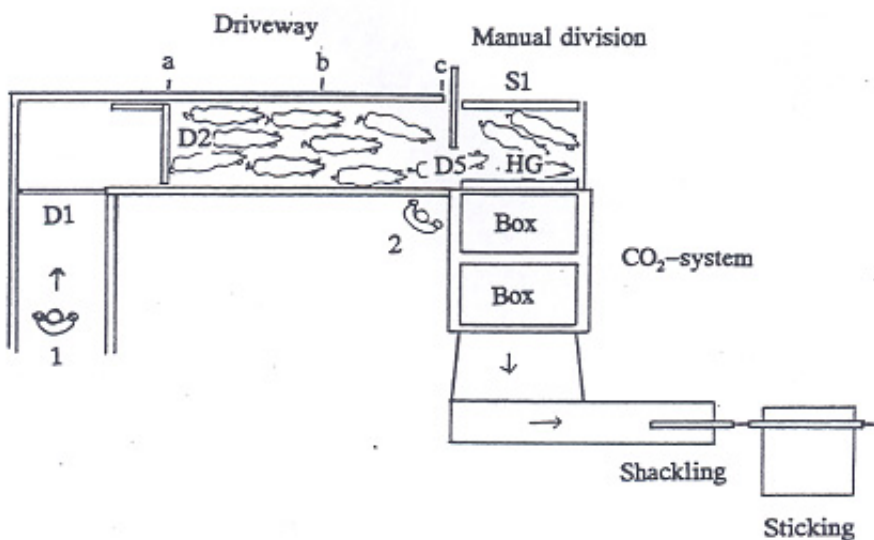
- an area, where the groups of 15 pigs are divided into smaller groups (eg. 5)
- automatic transfer of these smaller groups to and through the stunning equipment
- a system for presenting the stunned pigs for shackling and sticking.

As the pigs are stunned in groups, the concept assumes that CO₂-stunning will be used and this has several advantages. Pigs do not like to be isolated from one another and stunning in groups eliminates this problem. Moreover, pigs find restraint stressful and in modern CO₂-systems pigs are not restrained at all during the stunning itself.

Two different experimental set-ups have been tested, one where the division into groups is fully automatic and where three dip lift systems were used, and one that uses a manual division into smaller groups with a paternoster system. Only the latter system will be described in detail here (Figure 2).

Pigs are brought from the holding pens by operator 1 and the system closed off using the sliding door D1. At the same time push-hoist gate D2 begins to move to stop at position a. Gate D5 opens to allow pigs to pass and when 4-5 have entered the area immediately before the stunning equipment D5 is closed manually by operator 2 (or automatically using a video camera). When a stunning box is in place, hoist gate HG is raised and the opposite wall S1 guides the pigs into the stunning box. When the wall reaches its final position, the box side is lowered to close off the box, HG is lowered and S1 returns to its original position. The stunning box is then lowered into the CO₂ gas. D5 is then opened and 4-5 pigs enter and so on. D2 moves forward sequentially, stopping at b and c, stopping when D5 is closed and starting when D5 is opened.

Figure 2



When the box regains the top position with the stunned pigs, they are tipped out onto rollers, where they glide down onto a rapidly moving belt which moves them along to the shackling point. Pigs are then shackled and stuck.

From work on the fully automatic system some small advantages meat qualitywise can be expected but the main improvements in these systems are in animal welfare and working environment. Pigs move easily through the system without apparent stress, no vocalisation and minimal intervention from plant personnel. In particular no prods are necessary. Noise levels are therefore low in this area and this leads to considerable

improvements in working environment. The systems mentioned have been tested at slaughter rates of 400 pigs per hour. Division of pigs into smaller groups can, however, take place at twice this speed, and the number of pigs stunned at one time can be increased, so that there is no reason to doubt that the concept can be used at higher slaughter rates, while still maintaining optimal welfare and working environment.

Conclusion

Various options are now available with CO₂-stunning that allow high throughputs with a minimum of force and no use of electric prods. These systems will come into increasing use to improve pig welfare and meat quality, especially in abattoirs slaughtering pigs for customers who emphasise welfare when buying meat.

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