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Infra-red brooding of intensive livestock

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INTRODUCTION

Warm blooded vertebrates such as pigs and chickens are complex animals both anatomically and functionally. They are convenient production animals because they reproduce and grow rapidly and efficiently, and also because we know a great deal about their workings and requirements.

One important thing we know is that all their bodily functions are kept in a state of equilibrium by homeostatic mechanisms that maintain body composition, eliminate disease organisms, eliminate waste and, most importantly of all, maintain body temperature.

Infra-red heating or brooding has become highly adaptable to the high density stocking and modern management practices associated with commercial animal production. This Agfact explains how infra-red can be used effectively to maintain the body temperatures of intensive livestock.

ZONE OF THERMONEUTRALITY

For efficient production we need to balance the inputs to, and the losses from, the heating system.

Intensively housed livestock perform most efficiently in what is called a 'zone of thermoneutrality'. This zone is 17° to 27C for chickens and 19° to 25'C for pigs. Within these temperature ranges they grow faster and eat less.

The provision of warmer and cooler areas (hot and cold spots) allows livestock to move from point to point according to their temperature needs.

In chickens, the ability to control body temperature is very poorly developed at day-old and only begins to improve from 5 days onwards. Therefore, it is important that the body temperature of young broilers particularly is maintained to avoid chilling, stress and death.

HEATING TECHNIQUES

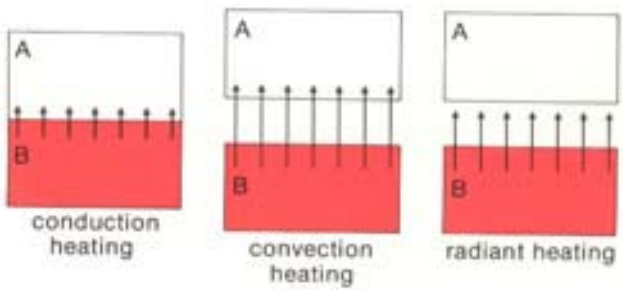
- There are three types of heating used with intensive livestock:
- conduction
- convection
- radiant heating.

Figure 1 graphically compares how each type of heating works.

Conduction heating. This heat is transmitted by contact. In our diagram you can see that body A is put in contact with body B, whose temperature is higher. This creates a heat flow from B to A and results in an evening-out of the temperatures of the two bodies. This heat is transmitted by conduction.

There are a number of reasons why conduction is not often used for heating intensive livestock. The main

Figure 1. The three types of heating used with intensive livestock.



reason is the high initial cost of installation, for example for slab heating.

Convection heating. This heat is transmitted via thermal currents through the air.

Our middle diagram shows that the two bodies A and B are not in contact. As B warms up, the air surrounding it becomes warmer and lighter and flows to A, gradually warming A until an energetic balance is reached.

Convection heating is often used in systems such as hot water-pipe brooding, but cannot be used for hot-spot brooding or in whole shed heating for pigs where farrowing areas need to be warmer than the growing areas.

Radiant heating. This heat is transmitted without any material (air or contact) support.

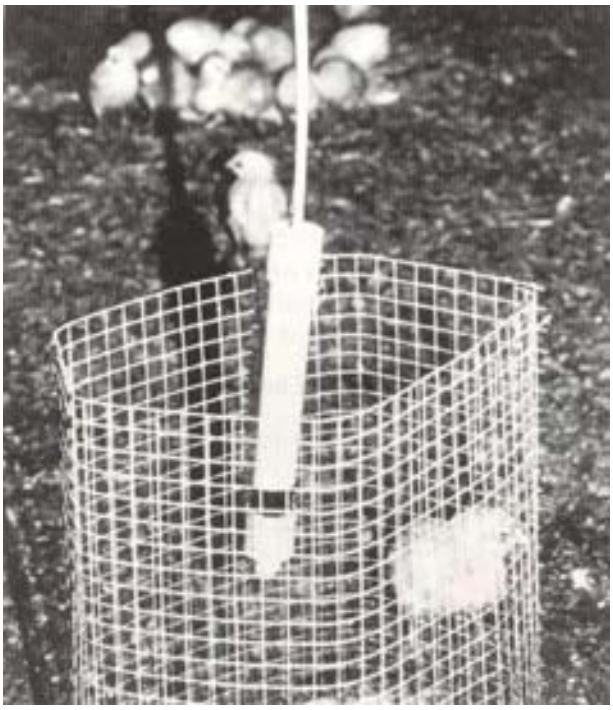
Again, in our diagram, we can see our two bodies on the right with B having the higher initial temperature. As all bodies radiate energy once they become warmer than absolute zero, B radiates more energy than A and becomes an emitter (brooder). This is typical of infra-red brooders, the most common method of heating intensive livestock.

INFRA-RED HEATING

Why use infra-red?

There are a number of reasons why infra-red is so popular:

Black bulb thermometers accurately measure the body temperature of the animals being heated by infra-red by means of a probe.—Photo: Ian Embury.



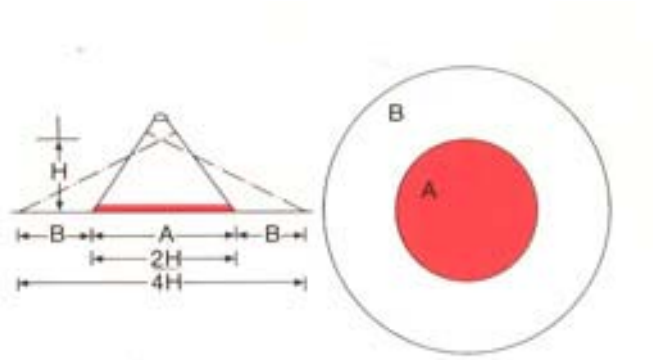


Figure 2. Determining the surface area heated by rays from a brooder.

- Its radiation can be directed.
- It penetrates the body of the animal; blood vessels dilate and blood and lymphatic circulation is stimulated.
- It is easily regulated.
- It provides immediate heat.
- No air circulation is needed to transport the heat.
- Brooding areas are easily adjusted and extended.
- It is easy and relatively cheap to install.
- Fuel can be stored, making brooder operation independent of blackouts and other disruptions such as strikes.

The most important requirements of brooders are:

- Their temperature must be adjustable day by day.
- Their temperature must be able to be set and maintained precisely.
- The producer must be able to check the temperature at any time.
- The temperature as recorded by the producer should be the temperature felt by the birds or animals.

How infra-red works

Infra-red is electromagnetic radiation of the same type as light. Its wavelength is slightly below visible red, hence its name.

Infra-red radiates in a straight line, which means its rays can be directed under certain conditions. It can be reflected from most surfaces, for example plaster, sand and cement (if they are dry) and most minerals and polished metals; these reflect 60 to 90 per cent of infra-red rays. Therefore the direction and concentration of the rays can be modified and they can be spread uniformly.

Infra-red turns into heat in an absorbent body. The amount of heat produced varies according to the wavelength of the rays, which in turn depends on the temperature of the source emitting them.

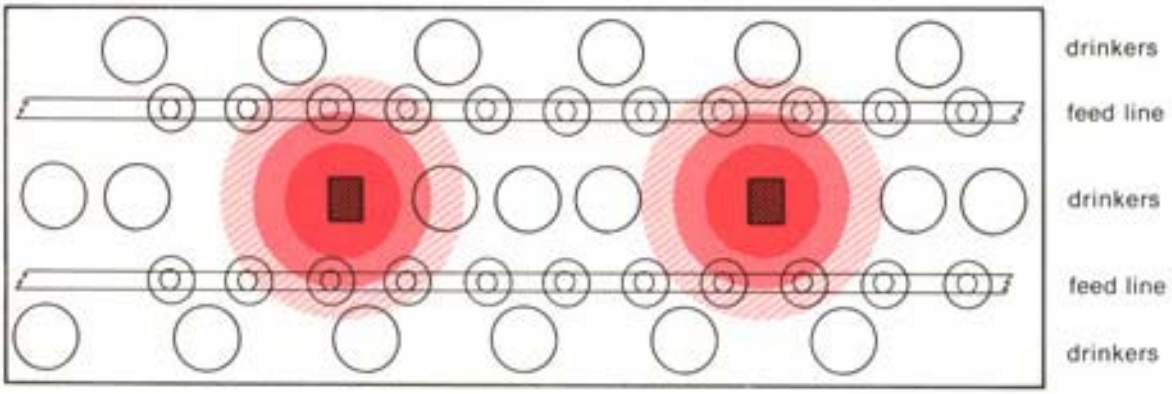


Figure 3. Floor plan of a broiler breeding shed, showing the zones of decreasing heat radiating from the infra-red emitters. Note the positioning of feeders and drinkers in the outer cooler areas of the hot spot

The heating capacity of a source depends on:

- its temperature
- its surface area.

Any radiating flow coming to a body from a number of sources will be cumulative.

As infra-red is insensitive to air (that is, it does not heat the air) it may be emitted in any direction within the same facility without needing any mechanical propulsion. In this regard it works in a similar way to the sun or solar radiation.

MEASURING TEMPERATURE IN A PRODUCTION SHED

There are several ways of checking the actual temperature provided to animals by an infra-red heater, and each has its own particular application.

- Electric thermohydrographs record air temperatures and humidity on graph paper.
- Electronic data loggers record 'black-bulb' temperatures and relative humidity on computer information cards by remote probe.
- Stem thermometers and mechanical thermographs register air temperatures on either a maximum-minimum or current basis.
- Black bulb thermometers measure the actual body temperature of the infra-red heated animal by remote probe and give the most accurate measurement of the infra-red heater.
- A hand-held infra-red thermometer that is capable of giving instantaneous surface temperatures on a digital display is a very accurate and useful apparatus. However, it is expensive and is seldom used in livestock production.

HANGING HEIGHTS OF BROODERS

Infra-red heat is emitted towards the ground and the animals' bodies within a defined area. Figure 2 shows the principle of determining the surface area affected by rays emitted by a brooder. Area A receives infra-red directly and is a well heated 'hot spot'. Area B only receives reflected rays and is the transition area for heat. The diameter of area A is twice the hanging height H.

Figure 3 shows the zones of decreasing heat emitted from infra-red brooders. Note how the 'hot spots' are positioned evenly throughout the brooding area to allow the chickens or other livestock to find their own comfort zones. They can then be grown with maximum efficiency without wasting energy in the maintenance of their optimum body temperatures.

Thus a good understanding of the mechanisms of temperature control will mean less food eaten per kilo of meat produced and worthwhile savings for the producer.

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