Reflections on incubation for profitable turkey hatching

by the Chick Master technical team.

For many years the production tools offered to the turkey sector by incubator manufacturers were simply a chicken setter and hatcher with tray frames spaced a bit further apart and with larger egg cups on the tray itself.

This approach to building equipment ignored the basic physiological differences between chickens and turkeys.

The turkey, despite its size and hardy appearance, is significantly more sensitive than the chicken to adversities and has a much more difficult time dealing with changing environmental conditions.

Coping with adversities

As a consequence of the large mass of the turkey egg, this lack of hardiness makes it far less capable of coping with temperature and humidity variations in a commercial setter or hatcher than its chicken counterpart.

The mass of the average turkey egg will generally be 40-60% larger than the mass of a comparable chicken egg. In both of these species the egg size will translate almost exactly into the chick size. That means that the heat production and energy consumption associated with the developing embryo will also follow the same percentage relationship.

A turkey hatcher trolley.

Single section turkey setter.

Two section turkey setter.

For some time now Chick Master have been researching, both at the theoretical level in the university and at the practical level in the hatchery, the interrelationship of egg condition, temperature, humidity and air flow.

Due to the noticeable lack of reliable research available this was a challenging exercise as it was only known that the process of hatching turkeys needed to be improved.

There were some obvious facts about the egg itself that were well known and documented. These included:

- Egg shape and appearance varies significantly from breed to breed.
- Egg size increases with age.
- The ratio of albumen to yolk changes as the flock ages so that while the yolk is larger in larger eggs, it is smaller as a percentage of total egg mass.
- Since the shell becomes thinner as the egg enlarges, there are usually fewer pores per square inch on larger eggs.

There were also some lesser known observations about the egg::

- Due to artificial insemination of the hen, the fertility of turkey eggs is generally higher than that of commercial broiler breeder eggs.
- Due to the size of the egg, the process of raising the internal temperature of the egg is far more difficult to control and predict than the same process in chicken eggs.
- The ratio of mass of the egg to shell surface area rises as the egg gets larger. Therefore, the larger the egg the more difficult it is for that egg to dissipate heat.

It was important to consider how the setter function impacts on both hatch numbers and bird quality. Issues here include:

- The setter must have adequate heating capacity to bring the internal temperature of the egg mass up quickly to the required temperature. The older the egg in terms of days in storage, the more critical the rapid rise of internal temperature.
- An embryo is like a wood burning stove. First it must burn enough of its energy source to make itself warm, then it can begin to warm the rest of the house (in other words, to grow). If the internal egg temperature is too low, energy must go into keeping warm. A young embryo is strong enough to do this for a reasonable period of time but an older, already weakened

Continued on page 14

Continued from page 13
embryo, is not. Early embryonic death and pips that do not have the energy to break out are typical warning signs of too slow a process in raising the core incubation temperature.

In addition, the setter function must be managed to avoid an adverse impact on hatch numbers and poult quality. This can be done by:

- Ensuring that the setter has the airflow characteristics that allow the heat in the setter to be evenly distributed from top to bottom and from front to back. We all know that warm air is lighter than cold air so it is inevitable that the top of an incubator tends to be warmer than the bottom. Fan shaping, fan speed, location of air impedance points and the positioning of the trolleys in relation to the fan itself all impact on the ability of the setter to counteract the natural desire of the heat to rise to the top of the setter. [1]While the temperature of the setter may remain constant and well controlled in studies provided by the manufacturer, the only real issue is the consistency of the temperature throughout the egg mass. The greater the variation of the egg mass temperature, the more dragged out or premature the hatch itself will be.

In order to optimise hatch numbers and poult quality, the setter must be able to do more than maintain the internal temperature of the setter itself.

It must direct the airflow over the egg mass with adequate velocity to remove the ever increasing heat from the shell of the egg. The shell is certainly an insulator, but it is far less of an insulator than the air curtain surrounding the egg itself.

The velocity of the air over the shell is the critical issue for removal of heat from a turkey egg. Therefore, the design of the setter must ensure that the air motion is rapid enough and directed properly to 'caress' the egg – simply flying by above the egg is not helpful!

Accordingly, heating up rapidly is important and, as egg age increases, this is vital.

Bringing the heat consistently to all of the eggs is critical for the healthy survival of the embryo and for maintaining a hatch with poults coming off temporally close together.

The velocity and direction of the air is the single most critical factor in determining the survivability of the embryo.

Hatcher field trials

When it comes to turkey hatchers, Chick Master are conducting field trials to verify the accuracy of their belief that the period in the hatcher, before the poult emerges, is when most of the damage is being done.

Once the poult emerges the surface area of its body allows for more efficient removal of heat than can possibly occur while the poult remains in the shell.

The amount of heat produced in the internal pipping and external pipping hours is significantly greater than at any other time in the hatching process. There is a common belief that the turkey embryo reaches a plateau sometime around the 25th day of the process and that this is due to the conductance levels of the eggs.

Eggs with high conductance shells (shells able to transfer gas easily) seem to plateau later in development than low conductance shell eggs, due to lack of available oxygen in the low conductance eggs.

However, the story is not that simple. The real culprit is the inability of the embryo to shed the heat it is creating in its limited world. As the temperature rises and the carbon dioxide levels rise, the growth capacity of the bird is restricted.

Tests have been run using Embrex equipment to punch a hole in the large end of the egg. These tests show that the hatch improves and the growth activity continues longer than it does for a normal egg. These tests show that the embryo has no desire to plateau. Rather the problem could be lack of oxygen.

It is far more likely that the punching of a hole in the shell allows the heat and gas inside the shell to escape which, in turn, creates an extended growing period – at least until the heat level once again rises to the point that growth must be curtailed.

Chick Master believes that the initial temperatures in the turkey setter should be higher than those typically published.

They are now experimenting with temperatures above 101°F (38.4°C) for the first four to eight days followed by a gradual reduction to temperatures as low as 98.0°F (36.7°F) prior to transfer. The results are very positive.

The ability of the setter to provide these varying temperatures is the main advantage of a single stage setter over a multi-stage setter.

Air flow

When it comes to air flow the vertically oriented paddle fan of the Avida system directs air flow around and back through the egg mass passing through just one tray of eggs.

There is no requirement to move diagonally as is required by a top or bottom fan which forces air through the egg mass from bottom to top – which in itself is the reverse of the most desired direction (remember, heat rises).

Blocking off of the trolleys in groups of three on each side of the fan forces air to flow from the outside wall back to the fan hub and this prevents air from flowing through the 'chimneys' between columns. Air must come in contact with the egg surface to do any good!

High altitude hatching has always used oxygen injection to maintain hatch numbers and chick quality.

A turkey hatcher.

This is more likely to be a requirement due to the lack of air flow over the eggs than it is of the amount of oxygen molecules in the air.

Chick Master are testing the impact of higher velocity, more directed air as compared to oxygen enriched air. They have yet to obtain conclusive results since this test only recently commenced.

Remember that in the early days of a set there is a significant cooling effect coming from the evaporation of the water from the albumen. Without good ventilation systems maintaining proper relative humidity in the air supplying the eggs, which are subject to rapid moisture loss at high altitude, is a challenge.

This, in turn, reduces the amount of cooling available to the embryo in the later stages of the hatch. It stands to reason that the temperatures in the hatcher must be cool enough to allow the embryo/poult to shed the internal heat that is currently stressing that poult.

If this does not occur this can lead to late dead in the hatcher and high mortality after placement on the farm.

Industry representation

The turkey industry has not been properly represented when the interaction of bird physiology and equipment designed to hatch the commercially required quantities has been investigated.

Chick Master is doing the research now that should have been done many years ago! They believe that they have already developed a setter that is better than any other on the market as well as a superior hatcher.

They promise to continue the research that will provide the operating guidelines needed to make the turkey hatching business as profitable as it can be. ■