The effect of hatcher temperature profiles on hatchability and quality

An eggshell temperature of 100°F (37.8°C) is widely accepted as optimal for embryonic development from the start of incubation up until transfer time. Eggshell temperature control in the setter has therefore become common practice to achieve optimal results.

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But what about the hatcher phase: Is an eggshell temperature of 100°F also the optimal setpoint after egg transfer? This article discusses the results of a Petersime trial that investigated three hatcher temperature profiles and their effect on hatchability and chick quality.

Temperature: the most important incubation parameter

It is commonly accepted that an eggshell temperature of 100°F (37.8°C) is optimal during the setter phase. Hence, most modern single-stage setters have adequate devices that monitor the eggshell temperature throughout the incubation process, steering the machine to meet the needs of the embryos. For instance, OvoScan-controlled setters use infrared temperature measurement technology to automatically adapt the machine air temperature in response to the actual eggshell temperature.

At around day 18 of incubation, all viable eggs are transferred from the setter into the hatcher, which is known to be a harsher environment.

Consequently, the question often arises if the reference value of 100°F is also the optimal eggshell temperature setpoint during the hatcher phase?

The answer is unfortunately not so easy to give because of some practical limitations to monitor the eggshell temperature inside a hatcher:

- Eggs move around freely in hatcher baskets, which makes it more difficult to use data loggers or scanning units.
- Air humidity levels are usually higher during hatching.
- Chick meconium and fluff can be a problem as they can cause sensor devices to become wet, dirty or even blocked.
- There are increased levels of dust, which makes it hard to get accurate measurements with infrared technology.
- Sensor devices can easily be damaged by chicks walking and pecking around.

Moreover, manual eggshell temperature measurement requires the hatcher doors to be opened, which would critically disturb the hatching conditions.

As a result, the usual practice is to apply pre-programmed hatcher temperature profiles based on the hatchery manager's experience (for example, by taking into account the specific breed, flock age, egg size, etc).

Table 1. The Mean Hatch of Fertile results (the standard deviation [SD] indicates the dispersion of the sample data from the mean).

	Cold	Standard	Hot
Eggshell temperature	98.5°F (36.9°C)	100°F (37.8°C)	10.5°F (38.6°C)
Mean Hatch of Fertile (%)	97.4 (SD=1.2)	97.6 (SD=1.0)	97.5 (SD=0.9)

Hatchers: more than merely a 'finishing machine'

Even though the hatcher phase makes up only three days of the total incubation time, this period has a significant impact on the hatch outcome. It is therefore essential to define which hatcher conditions produce the best hatchability and result in chicks of the highest quality. With good incubation programme management, the hatcher will enhance and optimise what has been achieved in the setter.

Various parameters affect the hatch outcome, but the aim of Petersime's current trial was to investigate the effect of deviations in eggshell temperature of +1.5°F and -1.5°F from the theoretical optimum of 100°F inside a hatcher.

The trial was carried out by conducting a series of small-scaled incubation cycles consisting of 900 uniformly sized eggs per cycle. All eggs were obtained from Ross-308 broiler breeder flocks between 30 and 40 weeks old. During the first 18 days of incubation, the eggshell temperature was controlled at 100°F.

After 18 days of incubation, the eggs were candled and all viable eggs were randomly grouped and transferred into three identical hatchers, each with a different target eggshell temperature:

- **Cold group:** target eggshell temperature of 98.5°F (36.9°C).
- **Standard group:** target eggshell temperature of 100°F (37.8°C).
- **Hot group:** target eggshell temperature of 101.5°F (38.6°C).

Aside from the machine air temperature, the environmental parameters in all three hatchers were similar. The eggshell

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temperature was monitored in real time by means of wired contact sensors (with ±0.1°F accuracy) and the machine air temperature was regularly adjusted to maintain the desired eggshell temperature setpoint.

At incubation day 19 and 19 hours (which was taken as a reference point for the first chicks to emerge from their shell), the target eggshell temperature of the three hatchers was again equalised and a standard hatcher temperature profile was followed until the end of incubation at 21 days.

The reason for this is that once chicks start to hatch and move around, eggshell temperature measurements are no longer stable. So, the eggshell temperature deviations between the three trial groups effectively happened between day 18 and day 19 and 19 hours.

From left to right: A-quality, B-quality and C-quality.

Results and discussion

● **Hatchability:**
The mean Hatch-of-Fertile results, summarised in Table 1 on page 15 show no significant differences in percentage due to the eggshell temperature deviations between the moment of transfer (day 18) and the beginning of hatch (day 19 and 19 hours). However, a closer inspection will confirm that 100°F is to be considered as the optimal eggshell temperature from set to hatch.

Contrary to the expectation that even a slight eggshell temperature deviation would significantly affect the hatch percentage, the results of the trial show otherwise. The 18-day-old/19-day-old embryos coped well with the ±1.5°F deviations and succeeded to hatch. This might be explained by the evolution in embryo thermoregulatory capacity.

During the first two weeks of incubation, an embryo is poikilothermic, which means it has an absolute low tolerance to any temperature deviations.

As of incubation day 14, the transition to the homeothermic phase begins. At 7-10 days post-hatch, a new-born chick has transformed into a homeotherm organism that can regulate its body temperature within certain limits.

● **Chick quality:**
As it is logical to assume that an embryo facing deviating eggshell temperatures has to 'compensate', causing other possible issues, we have also investigated how the same eggshell temperature deviations influenced navel quality, the prime indicator for chick quality.

A good quality navel is closed, dry and free of eggshell and membrane residues. A poor quality navel is a potential place for bacteria to enter the most sensitive part of the body cavity, which drastically increases susceptibility to diseases and the risk of post-hatch mortality.

The 'navel quality score' for the trial was divided into the following three categories, as shown in the photographs above:

● **A-quality:**
The navel area has healed well. Running a finger over it, you will hardly feel it. It is dry, smooth and almost flat.

● **B-quality:**
The navel has not healed properly and is wet or leaking. It feels rough to the touch and has a dark button or small string.

● **C-quality:**
A badly healed navel has a protruding, large dark button or a long string of non-absorbed membrane.

It is important to note that the A-B-C classification for navel quality used in the trial is not the same as the chick quality standards used during daily quality control in commercial hatcheries. In the trial, the navel details were individually checked and scored.

The C-quality chicks from the trial would be discarded as culls during chick grading at the hatchery, whereas the B-quality chicks from the trial would be included as saleable chicks together with the A-quality chicks.

Fig. 1 illustrates the average hatch percentages per trial group (Cold; Standard; Hot), but split by A-B-C chick quality categorisation.

These results show that relevant differences have been recorded.

The mean A-quality hatch percentages are higher for the Standard group (55.1%), followed by the Cold group (53.7%). At the same time, there is a significant drop in the results for the Hot group (43.7%).

Moreover, the Hot group shows a higher mean percentage of C-quality chicks (9.2%).

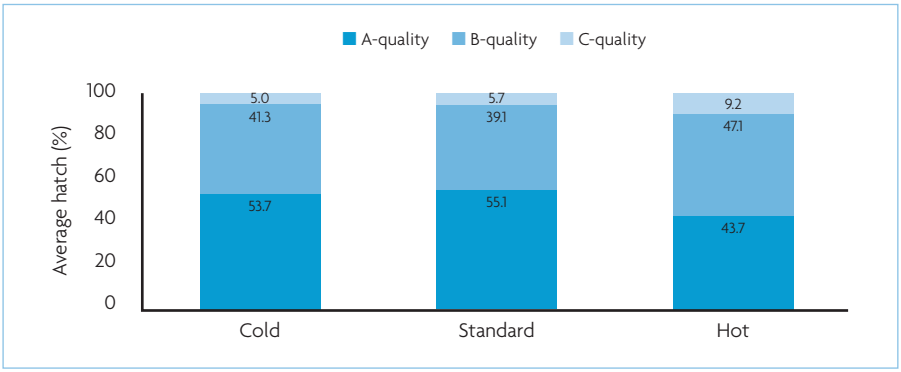
To summarise, the trial results suggest two important findings:

● The effect of eggshell temperature deviations in the hatcher is more substantial on chick quality than on hatchability.

● Post-transfer eggshell temperatures exceeding 100°F do greater harm to navel quality than lower eggshell temperatures.

The reason for this high temperature sensitivity might be found in an accelerated hatch. Heat speeds up the hatching process, which possibly results in insufficient time for proper yolk absorption and for the navel to heal properly.

Fig. 1. The average hatch percentages per trial group (Cold; Standard; Hot), but split by A-B-C chick quality categorisation.



Conclusion

It is recommended to primarily target an eggshell temperature of 100°F (37.8°C) after egg transfer to achieve optimal results.

A slightly lower eggshell temperature will also generate acceptable hatch results and adequate chick quality. However, high eggshell temperatures – for instance exceeding 101.5°F (38.6°C) – should be avoided. ■