Effective ventilation and a tight hatch window is the key to success

When planning a new hatchery biosecurity is an important consideration. The prevailing wind direction will dictate the hatchery's orientation, room and ventilation layout, drainage, personnel and product flows.

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Everything should always travel in a 'clean to dirty' – eggs to chicks – direction. Clean, fresh air will be drawn from the same end of the hatchery as the egg delivery dock. Drainage will always run away from the egg side towards chick despatch. Personnel areas should be situated centrally so that 'clean' and 'dirty' workers can be more easily separated and lower the risk of cross contamination.

Once this 'clean to dirty' concept has been established and strictly adhered to, you have given yourself every chance of maintaining the highest levels of biosecurity in your hatchery.

Fresh air can be filtered and UV treated before entering the main duct and air handling units that are dedicated to specific rooms – setters/hatchers/processing etc. Ventilation pressure cascades should always ensure that air can be moved from room to room in the clean to dirty direction. For the incubation rooms, modern day systems utilise automated pressure control that will not only ensure the correct air exchange for the setters and hatchers, but also that the pressure cascade is always respected. A small amount of air relief directly from the room to the exhaust plenum will also ensure an ongoing air exchange within each room, while always maintaining the correct pressure, temperature and humidity.

For modern (single-stage) hatcheries to operate at their full potential it is essential that the correct temperature, humidity and air pressures are maintained 365 days per year, regardless of climate and ambient conditions. Not only does this guarantee homogeneity of chick quality and maximum hatchability but also ensures that biosecurity is not compromised.

HVAC systems

Heating, Ventilation and Air Conditioning (HVAC) systems are generally recommended for new hatcheries throughout the world.

Hatchery ventilation systems should be designed for 100% fresh air supply and should not recycle room, or exhaust, air from setters and hatchers. While such a practice can (and does) help to maintain the moisture content of the air, it is extremely bad practice when the biosecurity of a hatchery is considered. The costs of HVAC can, to a lesser or greater extent, be offset by heat recovery systems especially in the temperate zones where animal heat from developing embryos can be reclaimed from the setters' warmed water return lines.

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EmTech's unique interlocking slip jointed panel.

Sophisticated incubator control systems, such as EmTech's Eclipse, can ensure that the correct temperature and humidity is very accurately maintained avoiding embryonic stress with expensive overshoots and uneven weight loss. Indeed, if good, consistent results and premium quality chicks can be guaranteed the case for HVAC is further advanced.

Often in the past, hatchery ventilation was treated as secondary to the incubator system that was being employed. Some incubator systems were very forgiving and would always produce average chicks using the most rudimentary ventilation.

Some systems required huge amounts of air to be rushed through the setters taking with it all that expensive heat, humidity and CO_2.

Some systems often struggled to get enough air to the extremities of the cabinet resulting in a wide hatch window and temperature band width.

With the advent of single-stage incubation and latterly the discovery that CO_2 is, in fact, beneficial in the early stages of incubation, ventilation became not just an expense but an important tool for achieving the highest quality chicks consistently and in the greatest numbers.

It was also soon discovered through regular monitoring of hatchery bacterial and fungal levels that biosecurity was easier to control with a 100% fresh air HVAC system and that outbreaks of disease were less common. Improved environmental conditions in chick processing rooms – especially when chicks required additional processing, such as vaccination and sexing, also contributed, as did the improved conditions for hatchery staff.

With HVAC, incubation systems (especially single-stage) can always run to their full potential by the accurately controlled delivery of optimal air volumes at the correct temperature and humidity levels for every stage of the embryonic development, 24/7/365.

While the ability to provide humidification of the air supply to setter and hatcher rooms is very important for colder climates, conversely, yet equally importantly, dehumidification is essential for optimal performance and optimal chick quality for hatcheries situated in tropical climates such as South East Asia, for example.

EmTech firmly believes that the tighter the hatch window the better the quantity, quality and liveability of the chicks. Forget the gimmicks, a tight hatch window is the best indicator that you have got it right – simple as that.

There is also a benefit to biosecurity if chicks hatch in a tight bandwidth, faecal matter, meconium and other potential contaminants have less time to endanger the hatcher environment.

It surely makes sense that if all of the chicks hatch around the same time they have all been exposed to exactly the same environmental conditions. Conversely, if the hatch window is wide it is a good indicator that the conditions within the setter vary considerably. This can be due to many factors but usually it is the lack of significant air movement in the extremities of the setter cabinet. This causes hot spots resulting in an accelerated development and exhausted, poorly conditioned, chicks. Or, conversely, cooler pockets of air, resulting in delayed embryonic development, insufficient weight loss and a prolonged,

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Incubation system	Flock age	Hatchery cull rate (%)	First week mortality (%)	Total mortality at kill (%)	Bird weight week 1	Final weight	Results compared to standard (%)	FCR	Standard FCR
EmTech PrimoTech PT12	34 weeks	0.36	0.45	2.8	0.181	2.437	106	1.54	1.617
Competitor's single-stage system	34 weeks	0.48	0.73	3.5	0.177	2.429	105.6	1.57	1.617

Table 1. Results for a 34 week old flock comparing EmTech with an existing single stage setting system at BroMargo, Margonin Hatchery, Poland.

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dragged out hatch which will stress these and the earlier hatched chicks.

There are, of course, other reasons why the hatch timing and hatch window can be wider (too early/late setting, long storage of eggs etc) but providing the eggs are correctly prepared, EmTech are confident enough to guarantee that for the PrimoTech single stage setter, the air temperature will be no more than ±0.35°C throughout the entire setter cabinet – top, bottom, centre and corners. This is certainly confirmed by recent hatchability and hatch window data gained from hatcheries in the UK and Poland.

As shown in Table 1, there was a 0.9% improvement of hatchability on a prime (34 week) flock. This, coupled with distinctly lower mortality and cull rates and improved bird weight, is testament that a tighter hatch window and improved ventilation can significantly improve performance and profitability.

EmTech has conducted many trials using thermal imaging to try and understand why there are temperature fluctuations within the setter and how to keep them to a minimum. Often it is because the paddle and impeller fans provide air movement in a regular pattern that can create static air pockets that are bypassed. We have also seen that fans are not powerful enough to penetrate several banks of eggs in trolleys especially when turned against the air flow. We also found that setter cabinets, especially those that are constructed with a framework of highly conductive aluminium extrusions can lose heat rapidly via these thermal bridges.

The results of the thermal images convinced us that we needed to rethink the design of our cabinets and now we use an interlocking slip jointed system that does not require aluminium supports.

We are also convinced that having just one double trolley located each side of the central fans provides the best opportunity for the air to consistently reach every single egg, creating a stable, homogenous environment that is required to achieve the best possible chicks.

What about multistage incubation?

It is often stated that a multistage setter environment can never really compare to a single stage environment for performance and chick quality and that a multistage operation is a compromise in respect to subjecting the entire egg mass (of six different ages of eggs) to the same conditions. However, again, just like a single stage setter, optimum performance and chick quality is very dependent on very good internal air flow distribution throughout the entire setter cabinet.

There is no better test of a setter's ability to transfer heat than that of egg shell temperature measurement and thermal imaging is a great way to check a setter's thermal characteristics. For optimum performance, egg shell temperatures should ideally be within a range of 37.8-38.3°C but this is very much dependent on the setter's'ability to create a good airflow and to efficiently transfer heat from embryos at the later stages of incubation to the embryos during the early stages of incubation, with the excess heat removed by the cooling system.

The thermal imaging comparisons that EmTech has conducted against a similar design and older multistage setter were extremely conclusive.

With embryos at 18 days of incubation, the older setter shows maximum egg shell temperatures of 39.5°C and 39.3°C. Whereas for our NovaTech Setter, measurements from the same trolley and tray positions show maximum egg shell temperatures of 38.3°C and 38.2°C.

That is 1.2°C cooler and, consequently, produces better chick uniformity and chick quality.

At the opposite end of the scale, with the embryos at only one day of incubation, the older setter shows an average egg shell temperature of 36.3°C and 36.6°C, while for the NovaTech Setter, measurements from the same trolley and tray positions show average egg shell temperatures of 36.7°C and 37.5°C. That is 1.1°C warmer which ultimately compressed the hatch window for improved chick uniformity and quality. The temperature set-point for both the older multistage trolley setter and NovaTech setters was 37.3°C.

Enhanced ventilation technology, coupled with precise control, is the key to ensuring that every single egg receives the correct environmental conditions within the setter cabinet.

For single stage setters, EmTech has developed reverse paddle fan technology and variable fan-speed as a standard feature of their stage programming procedure.

Air within the setter is now significantly disturbed driving it into areas that were previously hard to penetrate. Precise control of air exchange post seven days of incubation, in control of CO_2 and humidity is also a major factor in ensuring that chicks hatch consistently after achieving optimum development and weight loss.

In multistage systems, highly efficient impeller fans and a redesigned fan-board now provides over 25% greater average air flow through the egg mass resulting in greater heat transfer and a tighter temperature bandwidth. The improved airflow also creates a greater air pressure at the machine floor giving higher air velocities throughout the lower egg racks.

Conclusion

To conclude, a good ventilation system should be location specific and accurately sized to achieve a tight hatch window and the highest levels of biosecurity.

Intelligent incubator design coupled with sophisticated control systems will produce more and better conditioned chicks that will perform well on farm.

EmTech is a young company but probably has more hatchery industry experience than any incubator supplier operating in the world today.

We have questioned every aspect of incubator and ventilation system design and created new systems that have taken the best from the past coupled with the latest mechanical and digital technology to supply systems that not only work very well but are reliable, easy to operate and based on sound incubation principles. ■

Fig. 1. Day 7. Thermal image from the new NovaTech Setter, Trolley 7, Bottom, showing a minimum temperature of 36.9°C, an average temperature of 37.2°C and a maximum temperature of 37.5°C.

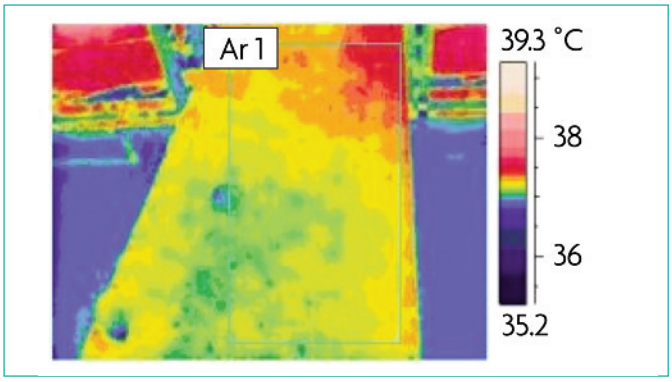

Fig. 2. Day 18. Thermal image from the new NovaTech Setter, Trolley 3, Top. Note that the temperatures are within the ideal range of between 37.8°C and 38.3°C.