Point down setting

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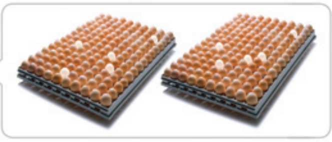
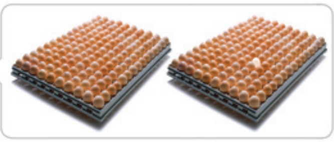
Manual setting

97.0%



Automatic setting

99.7%



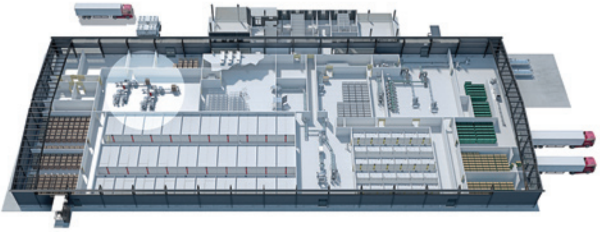
99.7% - 97.0% = **2.7%**

2.7 x 0.2%* x 52 million#

= 280,800 extra day old chicks per year

* A hatchery loses 0.2 percent of saleable chicks for every 1 percent of fertile eggs placed small end up in the setter tray *(Bauer et al, 1990)*
Further reading: 'The effects of setting eggs small end up' *(Pas Reform Academy, article 14)*

\# Hatchery capacity
1 million chicks per week



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The biology behind egg turning

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by Dr Marleen Boerjan, Director R&D, Pas Reform Academy

In addition to climate parameters such as air composition and temperature, turning is an important third parameter that needs to be controlled during incubation.

In commercial incubators, hatching eggs are placed in setter trays with the air cell up and turned regularly through angles of 90° or 45° on either side of eggs' long axis.

Historically, arguments for the need to turn eggs frequently were:

- Poor temperature distribution in the albumen and yolk.
- The risk of the embryo and extra-embryonic membranes adhering to the inner shell membrane.

Essential for development

From recent research, however, we now understand that turning hatching eggs during incubation is essential for the development of extra-embryonic membranes, including the amnion and the chorion-allantois respectively.

Simultaneously, extra-embryonic compartments are filled with sub-embryonic fluid, amniotic and allantoic fluids. Both membranes and fluids are essential for the optimum growth and development of the embryo (reviewed by Deeming 2002 in: Avian Incubation behaviour, environment and evolution); Baggott et al., 2002).

The formation of extra-embryonic membranes and compartments is fundamental for the transfer of nutrients from the albumen and yolk and, last but not least, from the shell to the developing embryo.

It is essential that embryonic development keeps pace with the development of the extra-embryonic tissues, so that when the day 12 embryo starts to grow, the yolk lipids are prepared for uptake by blood veins grown into a well developed yolk sac.

Well developed yolk sac required

If development of the yolk sac membranes and vascularisation lags behind that of the embryo, embryonic growth is limited. Lipids transported by the blood vessels from the yolk need a well developed yolk sac to be metabolised.

Turning is therefore essential during days 0-7, when the early extra-embryonic yolk sac membrane (area vasculosa and vitelline membrane) and sub-embryonic fluid are being formed.

Soon after incubation is initiated, extra-embryonic membranes develop from the outer area opaca of the blastoderm, as recognised by a clear ring of membranes on the yolk.

As incubation continues, blood vessels develop to form the area vasculosa (blood ring), which occurs simultaneously with the accumulation of sub-embryonic fluid. The volume of sub-embryonic fluid reaches its peak at day six of incubation. In the following days of embryonic development, the sub-embryonic fluid is transported to the amniotic cavity and the developing yolk sac.

Impact on growth

If turning fails during the period of sub-embryonic and blood ring formation, the area vasculosa remains small and the total volume of sub-embryonic fluid is decreased.

Consequently, failure to turn the egg has a serious and negative impact on the growth of the embryo. If embryos are not turned during days 4-7, nutrient uptake is affected, which delays hatching time and produces increased variability in chick viability.

We may confidently conclude therefore, that turning eggs is as important as climate parameters RH and temperature in incubation, not only for optimising embryo quality, but also in order to achieve a narrow hatch window.

Advice

- Recognise the importance of turning during the first week of incubation as being essential for achieving optimum embryonic growth.
- If by break out more than 75% of embryos are found dead in a similar stage of development, turning failure during the first 10 days of incubation is probably the cause.
- Turning failure may result in higher numbers of malposition II (head in small end), especially in eggs from older flocks.
- Increased spread of hatch and the presence of unexpectedly small embryos may also suggest a failure of turning during the first week of incubation.

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Water system design: analysis and treatment

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by Niek Yntema, manager HVAC development, Pas Reform Hatchery Technologies

The importance of water in the hatchery is well understood. Without water, washing/cleaning is practically impossible and many HVAC systems use water to provide optimal conditions for eggs, embryos, chicks and personnel.

Sub-optimal water quality and insufficient water supply can cause losses, by undermining hatching results, contributing to mechanical breakdowns and presenting hygiene risks. A properly designed water system is therefore critical to the success of any hatchery – and since good water is generally becoming more scarce and costly, it has become increasingly important to understand how to optimise the hatchery's water quality and supply.

In this, the first of two articles on designing a hatchery's water system, we look at typical considerations and approaches to the analysis and treatment of water.

Typical water analysis

A good hatchery water system starts with knowing the quality of the water source. This is commonly achieved by (regular) laboratory analysis, with typical parameters including:

- **Acidity/alkalinity (pH):** A pH of 7 is neutral. Below 7, the water becomes acid (can cause corrosion), while above 7 means the water is alkaline (can indicate hard water due to high levels of calcium). Generally a pH of 6-8 is acceptable – and pH can be corrected by adding chemicals.
- **Total hardness** is an indication of hard water, which can cause limescale build-up, resulting in inefficiencies or the breakdown of equipment. The most common unit used is °dH (German degree) or mg $CaCO_3$/l. Generally, 2-6°dH (35-107 mg $CaCO_3$/l) is advised, with a maximum of 2°dH recommended for nozzle/spray humidification. Water softeners are used to reduce water hardness.
- **Suspended particles** should be absent as these will block pipes, nozzles etc. Suspended solids are removed by filters.
- **Microbial contamination** should be absent. If water is contaminated, another source should be used. Disinfection can reduce contamination but using water contaminated with Pseudomonas, Acinetobacter, Proteus, yeasts or moulds – even after disinfection – for humidification is not advised.

Some elements in water are known for aggressive reactions which cause the discolouration of equipment. Commonly, the following thresholds are used: the total sum of chloride and sulphate (Cl and SO_4) max 200mg/l, Magnesium (Mg) max 50mg/l, Iron (Fe) max 0.02mg/l. These elements require specific treatments. Extremely pure water (for example distilled or Reverse Osmosis water) is also known to be aggressive. It is therefore advisable to build a small bypass into the system.

Water treatment systems

Depending on the differences between the results of water analysis and the hatchery's requirements, water treatment may be needed. Typically, water treatment is implemented using modular units:

- Filtration eliminates suspended solids, usually by means of cartridge and/or sand filters.
- Chemical treatment: usually antibacterial and anti-scaling treatments and/or a UV disinfection unit.
- Water softener, which reduces water hardness by replacing calcium and magnesium with sodium.
- Reverse osmosis, which uses membranes to separate dissolved salts, producing pure water.
- Pumps, sensors and control units, to monitor equipment function, with buffer tanks to balance the difference between supply and demand. Reject or backwash water needs to be drained.

Advice

- Determine water use in the hatchery, with details of specific needs by water quality and volumes, ensuring that future expansion needs can also be met.
- Have experts guide you in the proper analysis of the water and in the implementation of any water treatment and/or equipment needed.
- Carry out regular analysis and inspections, to ensure that the water treatment plant runs effectively and efficiently, without overusing chemicals.

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Water system design: sources and users

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www.pasreform.com

by Niek Yntema, manager HVAC development, Pas Reform Hatchery Technologies

The importance of water in the hatchery is well understood. Without water, washing/cleaning is practically impossible and many HVAC systems use water to provide optimal conditions for eggs, embryos, chicks and personnel.

Sub-optimal water quality and insufficient water supply can cause losses, by undermining hatching results, contributing to mechanical breakdowns and presenting hygiene risks.

A properly designed water system is therefore critical to the success of any hatchery – and since good water is generally becoming more scarce and costly, it has become increasingly important to understand how to optimise the hatchery's water quality and supply.

In the first part of this two-part article, we looked at typical considerations for water analysis and water treatment. In this second article, we look at sources of water and the hatchery's main users.

Water sources for the hatchery

In urban or industrial areas, water is generally supplied by the city's main utilities provider or 'city water'.

The quality of city water varies, from excellent potable water (comparable with bottled water) to undrinkable, hard, turbid, chlorinated water.

In remote areas or areas with insufficient city water availability, well or bore hole water provides an alternative, also typically known as hard water with high iron content, that needs treatment before use.

Depending on the difference between supply and demand capacity, buffer tanks may be used.

Water users in the hatchery

Water is required by the following main users/processes:

- Potable water (for taps, human consumption, showers, toilets). Volume is mainly dependent on the size of the hatchery operation and its staff and the number of chicks being hatched per week.
- Humidification (spray nozzles, rotating discs, fogging), consumption depends on the outside climate and on the volume of intake air.
- Circulating systems (chilled or hot water) are filled once and only require replenishing in the case of spills or leaks in the system.

  Note: the risk of limescale and water aggressiveness increases with temperature, making hot water systems more vulnerable to the development of sub-optimal water quality than chilled water systems.
- Production water (cleaning water for building, machines, trays, crates, trucks). Volume (expressed in litre/day old chick) varies significantly, depending on the hatchery's cleaning protocols, which may be one or other of the following extremes, or anywhere in between:

  – Not manually removing debris (shells, fluff) prior to washing, using low pressure water hoses (1-3bar) and manually cleaning and rinsing

  – Removing debris prior to washing. Soaking, using detergent foam. Cleaning with mid-to-high pressure water jets (25-100 bar). Using high-pressure industrial tray/crate/trolley washers with internal water circulation.

As a general rule, 0.35 litre/day old chick is the unit we use to design a system that will meet the whole hatchery's current and future water requirements.

The scale of the production water operation clearly has the potential to increase or decrease this calculation – and therefore the system's design – significantly.

Advice

- Determine water use in the hatchery, with details of specific needs by water quality and volumes, ensuring that future expansion needs can also be met.
- Investigate methods for reducing water consumption, including an analysis of options to reduce dependency on the variable efficiency and effectiveness of manual washing.
- Try to find the best match between your water needs and your source of supply, as correcting any imbalance in volume or quality will require investment in equipment that, aside from its financial cost, also uses space, energy and chemicals and will require regular maintenance.
- Avoid using rainwater for cleaning, as it may be contaminated with bird/rodent droppings. ■

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Energy-efficiency in pre-conditioning inlet air

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www.pasreform.com

by Gerd de Lange, Senior Poultry Specialist, Pas Reform Academy

Hatcheries are found in a variety of climates, from the hot, humid tropics of South East Asia to hot, arid zones in the Middle East or the changeable climates of Central Europe or the USA. Typically, external temperature and relative humidity are subject to seasonal changes (e.g. rainy season, very cold winters) or even a day and night rhythm. The challenge is to establish whether outside air is directly suitable for incubation and, if not, how to make it fit for that purpose. To a certain extent, setters and hatchers can deal with climatic variations to inlet air, although most incubator manufacturers specify the climate conditions under which their equipment will perform at its best. Untreated, inlet air can be:

- Too cold: this may lead to low temperature uniformity and, especially if occurring early in incubation, an extended hatch window.
- Too warm: during late incubation in the setter and certainly in the hatcher, this will overwork the water cooling system, produce excessive condensation and ultimately wet floors, which will cause eggs close to the floor to become too cold.
- Too dry: humidification (rotating disc, nozzles) in the incubator may compensate for this, but will cause cold spots due to localised evaporation.
- Too humid: this may cause difficulties in achieving sufficient egg weight loss during incubation, which can only partially be compensated for by a higher ventilation rate and might ultimately lead to reduced hatchability and poor chick quality.

Table 1 below shows a realistic range of climate specifications for setter and hatcher inlet air. For hatcheries at sea level, dew point specifications can also be converted to a specific humidity of 8.2-13.8g water/kg of air. There are several Mollier Diagram/psychometric chart-based climate calculation tools available online to help make these calculations. Conditioning outside air to inlet specifications is not without cost, as demonstrated in the following two examples:

- Outside air of 10°C and 75%RH: This air contains only 5.7g water/kg of air, which means that both heating and humidification is required to bring it within climate specifications. Just heating to 21°C is not enough, because subsequently adding water by spraying or fogging causes the temperature to drop again with evaporation. The most energy efficient option within the climate specifications is 21°C/53% RH (= 8.2g water/kg) and for that, the outside air should first be heated up to 27.6°C. This requires 17.8kJ/kg of air.
- Outside air of 30°C and 75%RH: Although relative humidity is the same as in the previous example, this air contains 20.2g more water per kg of air. Cooling this air down to 25.1°C will result in 100%RH, which equals the condensation or dew point. However water content is still the original 20.2g/kg of air; further cooling to 19°C is required to achieve the maximum specification of 13.8g water/kg of air. This air, however, is still too cold and should be heated up to at least 21°C. But at that temperature, relative humidity is 88% – far higher than the maximum specification of 70%. To reach that relative humidity, heating up to approximately 25°C is required. The energy required for cooling from 30-19°C is 27.6kJ/kg of air and subsequently heating to 25°C takes another 6.1kJ/kg of air.

Advice

- Consult your incubator manufacturer for setter and hatcher inlet air climate specifications.
- Choose the most energy efficient (cheapest) combination of temperature and relative humidity within these specifications after taking outside climate into consideration.
- Ask your incubator manufacturer about available options to further reduce the energy costs for hatchery climate control.
- Do not waste expensive, pre-conditioned air: avoid over-ventilating your incubators and keep the doors of clean air plenums closed as much as possible.

Table 1. Example of climate requirements for setter and hatcher inlet air. Above 70% RH increases the risk of fungal growth.

Temperature	Relative humidity	Dew point
21-27°C (69.8-80.6°F)	<70%	11-19°C (51.8-66.2°F)

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On-farm traying: a smart idea?

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by Gerd de Lange, Senior Poultry Specialist, Pas Reform Academy

On breeder farms eggs are traditionally collected in paper or plastic trays that each hold 30 eggs. Typically, these are stacked six-high and transported to the hatchery in boxes, crates, trolleys or on pallets.

Before incubation, hatchery staff have to transfer the trayed eggs to setter trays, either manually or (semi)-automatically. So far, each hatching egg has already been handled at least twice before incubation begins – and each time with the risk of causing hairline cracks and contamination that will ultimately undermine hatch results.

On-farm traying, both manual and automatic, is becoming increasingly popular as it minimises labour and reduces the need for egg handling. With the eggs already placed on setter trays at the breeder farm, they are then transported in specially designed farm trolleys to the hatchery, where the setter trays are transferred from the farm trolleys to setter trolleys. The eggs are not handled individually any more – and even this final transfer before incubation can be automated.

When choosing a tray type for egg collection on the farm and subsequent transport to the hatchery, there are several important considerations that will also have important consequences for managing the hatching eggs:

Rate of cooling down

Egg temperature at the moment of collection varies from egg to egg. For those still holding a temperature of >25°F/77°F, further cooling is required. When placed at the centre of a paper tray and covered by the next full tray, a newly laid egg with a temperature closer to that of the hen's body (41°C/105.8°F), will take much longer to cool down than an egg placed at the side of the paper tray. And packing warm eggs on paper trays directly into egg boxes will certainly lead to high embryonic mortality!

With a more open construction and the fact that they are not stacked directly on top of each other, filled setter trays allow sufficient freely circulating air to pass around the trayed eggs. This greatly promotes uniform cooling, but if temperature in the egg collection room is too low, there is a risk that the eggs will cool too rapidly, especially if exposed to cold air or a draught.

Plastic trays provide a mid-point between paper trays and setter trays, because plastic is not as good thermic insulator as paper and it will allow some air flow over the eggs.

Mechanical impact

During loading, transport and unloading, shocks and jolts should be avoided, both to prevent damage to the fragile embryonic structure and hairline cracks in the shell.

Eggs are generally very well cushioned when transported on paper trays, so where road conditions are poor or trucks have poor suspension, paper trays may be the best choice. In other cases, well-designed setter trays without sharp edges provide good support for the hatching eggs and, when placed in farm trolleys with shock absorbing wheels, offer a valid alternative.

Further treatment of hatching eggs:

Placing eggs on setter trays is essential for effective disinfection or pre-storage incubation, neither of which is possible when eggs are tightly packed together on paper or plastic egg trays, as there is no free space around each egg.

Advice

- Think broadly about the various 'touchpoints' that hatching eggs will be subjected to from farm to hatchery when choosing a tray type.
- Choose paper trays when road or vehicle conditions from breeder farm to hatchery are poor.
- Recognise that eggs on setter trays may cool down too quickly after egg collection; do not place them immediately in the cold room. ■

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The advantages of using honeycomb high capacity trays 79

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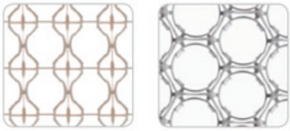
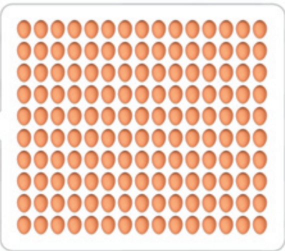
by Gerd de Lange, Senior Poultry Specialist, Pas Reform Academy

SmartTray 162



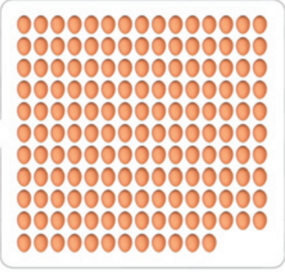
150 egg tray

150 eggs



162 egg tray

162 eggs



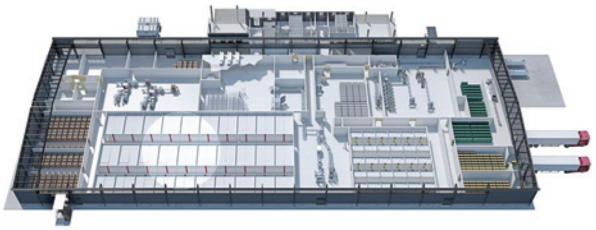
12

12 more eggs

$\frac{12}{150}$ x 52 million = **4,160,000 extra day-old-chicks per year**

Hatchery capacity
1 million chicks/week

SmartTray 162 is designed in a space saving honeycomb structure for the highest number of hatching eggs per m^2. Designed to cradle eggs of any size safely, SmartTray's open construction is proven to deliver uniform airflow during incubation. This helps to create an optimal environment for the growing embryos, promoting day-old-chicks of the highest quality.



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The benefits of the energy saving module

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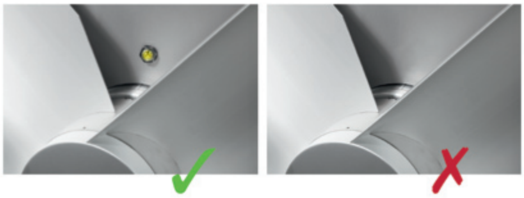
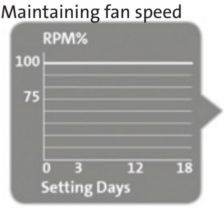
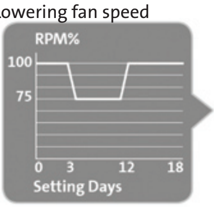


Maintaining fan speed



100%

Lowering fan speed



71%

29%

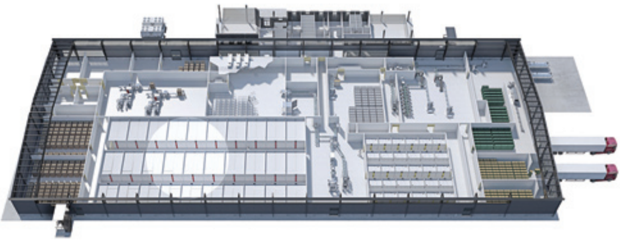
Average fan power consumption per egg per setting cycle.

$$29\% \times \frac{18.25}{1000} \times 52 \text{ million} = 275{,}210 \text{ kWh per year}$$

Hatchery capacity 1 million chicks/week

While high fan revolution speeds are needed at the beginning and during the final phase of incubation to optimise the heating and cooling of the hatching eggs, this level of energy consumption is not required during the long period in between.

The ESM energy saving module allows the number of revolutions to reduce substantially during that part of the process.



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