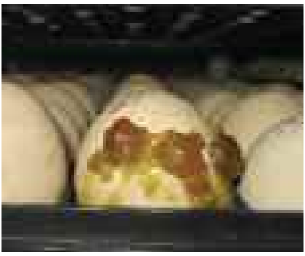
Dealing with exploders 33

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

Hatchery employees, especially when involved in transferring eggs from setter to hatcher, are occasionally confronted with so called 'bangers' or 'exploders'. A loud bang, followed by a very bad smell, are the usual signs.

This phenomenon is caused by gas producing bacteria, often Pseudomonas spp., inside the egg. Pressure inside such an egg builds up and even a small vibration can be enough to trigger the explosion.

During the second half of incubation, this also occurs without human involvement within the setter; empty places in the setter tray and pieces of shell and rotten egg contents on the floor or other eggs are the visible signs. The gas can also press a foamy yellowish substance through the pores of the egg – which makes a potential exploder easy to recognise. Exploding eggs lead to heavy bacterial contamination, putting the hatchery's hygiene status at risk, with negative effects on hatchability, chick quality and subsequent performance.



Eggs are not laid in a sterile environment. Even a visually clean egg has 1,000 to 10,000 bacteria on its surface. This does not naturally cause a problem, as eggs are very well protected against bacterial penetration. However, sometimes the egg's defence mechanism is breached, as in the case of eggs produced in wet floor or nest litter.

These eggs can later be potential exploders, because directly after laying the cuticle does not offer full protection and bacteria counts are high in these conditions.

Moreover the shrinkage of its contents as an egg cools down to environmental temperature will suck bacteria deep into the pores.

Water on the shell also facilitates bacterial penetration, which is why it is important to avoid condensation on the egg shell, commonly called 'sweating', which can occur if cold eggs are suddenly exposed to a higher temperature.

When flocks age, the cuticle becomes thinner and the shells weaker, with an increased risk of hairline cracks, which allows bacteria easy access to the egg's interior.

The natural antimicrobial compound lysozyme, together with the bacteria-unfriendly alkaline environment of the albumen, prevents rapid bacterial multiplication. This may even kill all bacteria, if there are not too many. But once the eggs are exposed to incubation temperature, this defence mechanism no longer offers protection. The combination of incubation temperatures and the ready supply of nutrients in the egg will cause the number of bacteria to increase exponentially. To completely eradicate exploders may not be achievable, but by good management their number can be kept to an acceptable minimum and the negative consequences of an incidental exploder can be controlled.

Advice

- Do not set floor eggs, dirty eggs and eggs with hairline cracks, as these are potential exploders.
- Only set floor or dirty eggs if the disadvantages of setting these eggs are fully understood and accepted, in which case they should be placed on the lowest trays.
- Transfer eggs from older flocks after the eggs of young flocks have been transferred, to avoid cross contamination.
- During candling or transfer, remove potential exploders manually and dispose of them either in a bucket with disinfecting fluid or by a vacuum system.
- Clean up the mess after an exploder immediately with a new, clean paper tissue, followed by wiping the area with a cloth soaked in an appropriate disinfectant.
- Consider disinfecting infected batches after transfer with an appropriate disinfectant.
- Plan chick take-off and further handling of infected batches at the end of the day.
- Intensify hygienic procedures, including cleaning and disinfection of the hatchery and all equipment that comes in direct contact with eggs and chicks to reduce the spread of bacteria. ■

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Reconciling maternal (flock) age and chick quality 34

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By Marleen Boerjan, Director R&D, Pas Reform Academy

The expression 'chick quality' is a general term, often used by hatchery managers to describe the appearance of a batch of day old chicks. In this context, chicks deemed to be of 'good quality' are active with closed navels, a soft, smooth yolk sac, no red hocks and a clean beak. In such a batch, the birds are uniform in appearance and weight.

A main cause of non-uniform day old chick quality is variability in the quality of hatching eggs. Day old chick weight and quality is determined by flock age, with factors such as strain (genetic background) and weight loss during incubation also influencing the overall quality of the chicks.

Genetic selection for growth, lean meat and FCR is negatively correlated to reproductive efficiency. The management of broiler breeders to optimise the production of good quality hatching eggs is therefore more challenging now than in the past. Uniform egg size depends on flock uniformity – and therefore on pullet growth management, nutrition and lighting schedules.

As the flock ages, we see an increase in the weight of the eggs it produces and consequently, an increase in recorded day-old chick weight (Table 1). An experienced hatchery manager knows that the quality of chicks will decrease when eggs are derived from aged flocks.

This is often observed in higher numbers of chicks showing a bad navel and red hocks in batches from flocks older than 50 weeks. Poor chick quality as the flock ages is also recognised by slower growth during the first week (Table 1) or when evaluating the morphological parameters used to calculate the Pasgar score for chick quality (Fig. 1).

The exact reason that day old chicks from older flocks are of reduced quality is not known, but it is most likely to be related to inadequate egg content and/or improper incubation conditions and/or pulling times. For example, in the routine of a hatchery, incubation times may not be adjusted to variable flock age. This may result in chicks that are too 'fresh' from very young (29 weeks) and very old (59 weeks) flocks, or dehydrated chicks from flocks in peak production, since chicks from very young and very old flocks hatch later than chicks from peak production flocks.

Advice

- Incubate batches of eggs derived from one flock in one incubator whenever possible. When different batches must be combined in one incubator, try to ensure that the eggs are from flocks of similar age.
- Pull chicks according to flock age: chicks should be dry but not dehydrated. Pulling time is correct if 5% of chicks are still a bit wet, ie. with down feathers that are not completely dry, at the neck.
- Evaluate chick quality using a quality score system such as the Pasgar score.
- Adjust the incubation program if chick quality is below your reference. ■

Fig. 1. Evaluation of individual morphological parameters used to calculate the Pasgar score of chicks from young and older flocks. Pasgar score of chicks from older flocks is lower because the percentage of chicks with an abnormal reflex (black); navel (green); hocks (red); beak (blue); large yolk sac (yellow) is higher.

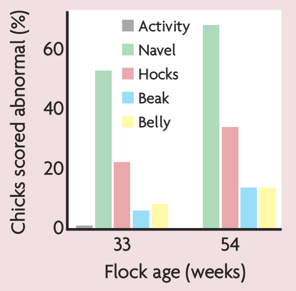

Table 1. Production parameters related to age of broiler breeders.

Age (week)	Egg weight (g)	Scored for high quality (%)	Day-old chick weights (g)	7 day chick weights (g)	Relative growth up to 7 days (%)
35	66.4±0.5	97.7±1.3	45.2±0.4	141.4±2.0	206.9±5.1
45	70.6±0.6*	93.7±2.2	49.4*±0.4	140.4±1.8	185.5*±4.2

*Data significantly different ($P<0.05$); From Tona et al, 2004: J. Applied Poultry Research 13:10

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Modernising or expanding a hatchery 35

by Sander Koster, project manager hatchery design, Pas Reform Hatchery Technologies

When building a new hatchery, we have the freedom to plan exactly what we need, where we need it, right down to laying the groundwork for future expansion.

Modernising or expanding an existing hatchery poses more of a challenge. When installing or modernising incubators or automation equipment, limitations can come from standing structures (walls, columns), piping, ducting, etc., which cannot always be moved or removed as required. A review of existing facilities with the architect or building contractor, including planning permissions where applicable, should be the first step in any decision to rebuild or expand an existing hatchery.

Invariably there are choices that have to be made. Is it viable to achieve 'optimal' routing by demolishing and/or rebuilding walls? Or does a 'compromised' routing work better, while retaining as many existing walls as possible? What type of materials will be used to rebuild the hatchery? Will modernisation or expansion be in an existing part of the hatchery, or require additional building? And will the project be well served by extending existing systems and infrastructure – or will it require additional energy, air and water supplies?

The infrastructure of the hatchery should be considered. Involve plumbing and electrical contractors, for example, in reviewing hatchery service installations – and the consequences of modernisation or expansion. Piping and ducting are easier to replace than standing structures – but consider that existing services must keep running alongside any new installations during rebuild or construction.

With a good review of the existing hatchery and a thorough understanding of any restrictions, designing the new hatchery layout can begin.

Care in scheduling building phases, materials and contractors will help keep budgets and timescales on track, as will clear, responsive communication between all the parties involved. With everyone's involvement, it is a good idea to document the work that needs to be done, who will do it – and when it should be completed.

Advice

- Review any permits, applications and licenses that are required to modernise or expand the hatchery.
- Check that there is sufficient capacity in existing energy supplies for modernised/expanded hatchery systems – or make alternative plans for energy supplies.
- Separate construction area(s) as much as possible from existing hatchery operations.
- Prepare the logistics of the project so that suppliers and contractors spend as little time as possible inside the operating hatchery.
- Consider building in separate phases when very large changes are necessary.
- Keep one master planning document on record, so that everyone, including external contractors, know exactly what needs to be done and by when. ■

Ergonomic benefits in the hatchery 36

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by Henry Arts, marketing director, Pas Reform Hatchery Technologies

The hatchery is generally regarded as a safe place to work, reporting very few incidents when compared with other industries. In practice, that does not mean that working in the hatchery is entirely without risk.

A proper regard for Health and Safety in the hatchery requires great care in managing factors such as dust, noise, climate and the use of chemicals, for example.

However, incidents among hatchery personnel tend to arise from more subtle causes related to repetition, force and posture: factors with effects that often develop over time. This article focuses on these areas and the positive impact that results from the use of ergonomics in industrial design.

Muscular pain affecting the wrists, shoulders, neck and back are potential challenges for hatchery employees, with three major factors that may contribute to such complaints in this environment:

- Highly repetitive tasks: repeating the same motions over and over again, quickly and with little variation, eg. when manually transferring hatching eggs from pulp trays onto setter trays.
- Carrying heavy weights.
- Working in suboptimal positions, for example with the hands raised above shoulder level for prolonged periods or repeatedly, such as is required when manually loading a setter trolley.

Factors such as repetition, force and posture can be largely controlled and overcome by improved working practices. But in the hatchery environment, the use of ergonomics in the design of incubators, hatchery automation and climate control systems is also known to substantially benefit both the hatchery and its personnel. By opting for ergonomically designed equipment, the hatchery demonstrates its care for personnel over the long term. Thoughtful engineering translates into a safe, efficient environment that, with simple-to-use operator interfaces, also reduces the risk and cost of mistakes.

The aim of ergonomics is to control risk factors associated with an individual's comfort, efficiency, safety and productivity, through improved working practices and optimised industrial design in the workplace. By delivering better performance and job satisfaction, sound ergonomic sense also makes good economic sense.

Modern hatchery equipment manufacturers place great importance on ergonomics during product design and development.

Advice

- Reduce the frequency and duration of repetitive motions, by implementing job rotation to move hatchery employees around a number of different tasks. To avoid any risk of cross-contamination, personnel should only be rotated within the same area of operation within a single shift.
- Deploy ergonomic lifting and transport tools such as scissor lifts, setter trolley loaders, stackers, destackers, hand dollies, carts and forklifts, to reduce the load. Objects that must be lifted manually should be placed at waist level.
- Make the operation of incubators, hatchery automation and climate control systems simple, safe and easily accessible to operators of all skill levels; ensure that any software used is suitable for the personnel using it, avoiding information overload.
- Consider the viewing angle of a machine's user interface and use large, high-contrast, high resolution colour screens with clear icons that allow for optimised viewing and configuration.
- Make use of highly manoeuvrable trolleys with swivel wheels and ergonomically designed handlebars for ease in loading and unloading incubators. Handlebars should ideally be waist height.
- Opt for lightweight setter trays and hatcher baskets, with a smooth finish and lateral hand holds for maximum grip and comfortable handling. ■

Selecting a hatchery location

by Sander Koster, Project Manager Hatchery Design, Pas Reform Hatchery Technologies

Having made the decision to build a hatchery, finding the right location is a critical first step. Not every piece of land is suitable as a hatchery site – and finding a good location that is fit for the purpose deserves some time and proper investigation, in order to give the hatchery a good start.

There are five key factors, namely district ordinance, environment, infrastructure, altitude and soil, which should be carefully reviewed to determine whether a location is suitable or not.

Consider district ordinance and any permits that may be required to begin constructing the hatchery. As an industrial building, there may be concerns for example over pollution or other environmental impacts, which could result in restrictions at the selected location. Are there any development plans for the future of the area where the hatchery is intended? Checking these aspects of your hatchery plan before investment begins is always advisable.

To maintain high level biosecurity, the hatchery should be located at least one to three kilometers from any other poultry and livestock farms. Prevailing wind direction should be monitored, especially in relation to the hatchery's air inlet and exhaust points, to avoid introducing dust and contaminants from the environment.

A good infrastructure foresees the hatchery's accessibility, energy and data communication needs, both for start-up and in the future. Easy access is an absolute necessity for the modern hatchery. A badly surfaced road will cause vibration to the eggs on the truck, which may reduce egg quality. As importantly, the location of the hatchery in relation to its farm customers can significantly improve logistics and help to reduce costs.

The hatchery needs energy to operate and, depending on its size, a certain amount of electrical, cooling and heating capacity. These can be provided by a variety of energy resources. The primary supply may be mains power from the local power grid and a nearby lake or river, for example, may provide an excellent source of cooling. For all the hatchery's different energy needs, it is critical that an uninterrupted supply is available – and wise to ensure that back-up installations are in place.

Data communication is fundamental to any modern business. Good access to the internet will enable machinery software to be updated and support functions to be accessed remotely, as well as enabling anywhere, anytime logins, to check on operations.

Hatchability and chick quality are affected by altitude. Barometric pressure declines with altitude, as does the partial pressure of oxygen and absolute humidity. Fresh ventilating air will tend to be colder and drier at altitude than at sea level. These affects can be minimised, depending on the altitude at which the hatching eggs are produced and the corresponding adjustments made to the incubation programme.

Finally, the properties of soil types do differ and may, for example, be more prone to expansion or shifting than other types. If the ground at the new hatchery site is unstable, this could compromise the hatchery structure, causing cracks in the walls or problems at foundation level. Soil testing will determine the type and depth of foundations required for your hatchery, enabling an accurate cost projection for the type of groundwork necessary.

Advice

- Review any planning consents or restrictions and any future development plans for the district in which the hatchery will be located.
- Monitor and maintain a high level of biosecurity for the area surrounding the hatchery, to minimise or prevent any risk of contamination.
- Ensure that energy supplies are stable and reliable, to protect the hatchery against failures or damage to machinery.
- Consult a specialist for advice and guidance in relation to the effects of altitude on the incubation programme.
- Probe the location's geographical features and soil properties, to inform the development of the hatchery's groundwork. ■

Pre-storage incubation: a matter of routine? 38

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

The care of hatching eggs during storage – at the farm, in transit or at the hatchery – is an important aspect of hatchery management that aims to preserve the vitality of the embryo.

With optimum temperature and relative humidity, hatching eggs can generally be stored for one week without significantly reducing hatchability or chick quality. Eggs stored for longer than this are known to benefit from lower storage temperatures (12-14 °C) (Fasenko, 2007; personal experience).

Pre-storage incubation, i.e. incubating hatching eggs before they are placed in the storage room, is a new approach to storage management that aims to develop the embryo to the so-called hypoblast stage: a stage of embryonic development that is better able to survive storage.

According to Fasenko (2007), broiler hatching eggs reach the hypoblast stage after six hours of pre-storage incubation, turkey embryos after 12 hours.

Layer hen hatcheries have reported improved performance, seeing 3-7% more females after pre-storage incubation for 3-6 hours, when eggs are stored for more than 11 days (Lohmann Tierzucht, Manage-ment Guide).

In the broiler industry, positive pre-storage incubation results show at least a 1% increase on expected hatchability, when the eggs undergo pre-storage incubation of 3-6 hours on arrival at the hatchery (Fasenko et al., 2001; Fasenko, 2007). Eggs scheduled for storage for more than seven days after production benefit most from pre-storage incubation.

However, many questions, mainly concerning timing and duration, continue to surround the adoption of pre-storage incubation in routine management practice.

Considerations for the practice of pre-storage incubation

Pre-storage incubation is only beneficial if the embryos in the eggs are in a very early stage of development. For example: if nest temperatures are high and the eggs stay in the nest too long, the embryos may develop beyond the storage resistant stage, when pre-storage incubation will increase early embryonic mortality.

Small-scale experiments will help identify the best timing and length of pre-storage incubation for your own hatchery and egg types (see below).

To assess results in your own hatchery:

- Place eggs for pre-storage incubation on setter trays in setter trolleys, to ensure uniform egg temperature during incubation.
- Do not incubate eggs on paper trays or in boxes. This guarantees heterogeneous egg/embryo temperatures, resulting in high levels of early mortality.
- Disinfect eggs as long as pre-storage incubation is performed in a setter located in the setter room ('clean area'). Ideally use a specific incubator, located close to the egg storage room.
- Pre-storage incubation can be applied when eggs arrive at the hatchery 3-4 days after production and are scheduled for more than four days extra storage at the hatchery. ■

Guidelines

To assess performance benefits and establish pre-storage incubation protocols in the hatchery:

- Egg selection: per egg type, three trolleys for pre-storage incubation with one trolley (same batch) for the control.
- Disinfect: if the eggs are incubated in a normal routine setter.
- Pre-storage incubation: place trolley(s) with (disinfected) eggs in a running setter at incubation temperature. Incubate the eggs for 3, 6 and 9 hours. Control eggs stay at storage temperature.
- Return pre-storage incubated eggs to the storage room (with control eggs) for at least seven days before starting the normal incubation cycle.
- Run normal incubation with both the pre-storage incubated eggs and the control eggs.
- Evaluate: compare hatchability – pre-storage incubated eggs vs. control eggs.
- Repeat this experiment with eggs from at least three different flocks.
- Evaluate all results. If positive, adopt pre-storage incubation routine as indicated by results.

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Incubation times in the modern hatchery

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

The chicken embryo generally needs 21 days (504 hours) to complete incubation, including the drying of down (Etches, 1996). In practice however, incubation periods vary considerably, as observed by Laughlin (2007) in large scale field surveys, which recorded pulling times from the setting of eggs of 500 up to 526 hours (see Fig. 1 below).

This variation can partly be explained by differences in the time required to heat the eggs from room temperature to incubation temperature (100° F), either due to initial egg temperature and/or the different heating capacities of incubator types.

Incubation time also varies because the growth rate of the embryos differs between batches of eggs. Flock age and egg storage are the best known parameters for influencing embryonic growth rate and, thus, hatching times.

As a general rule, eggs stored for more than five days need one hour more incubation time per day of storage. Eggs from peak production flocks hatch earlier than eggs from younger or older flocks. This observation from practice is confirmed by small scale experiments published in several scientific papers, whereby the average incubation period for different broiler lines varied between 498 hours for flocks of 35-45 weeks of age and 508 hours for younger (<30 weeks) and older (>55 weeks) flocks.

There may be two distinct explanations for the shorter incubation time of eggs from peak production flocks.

Firstly, higher fertility in these eggs means that the number of heat producing eggs on the single tray is increased. This may result in higher average embryo temperatures, inducing accelerated development and therefore an early hatch.

Secondly, hens in peak production are of optimum physiological reproductive age. They produce good quality eggs and embryos that grow at an optimum rate, which may result in an early hatch. Single stage incubation enables the finite control of embryo temperature and thus hatching time. In contrast to the management of incubation temperature, the opportunity to influence egg specific factors, such as flock age or egg size, is limited. However, based on experience, the hatchery manager can tailor egg specific programs using single-stage incubation.

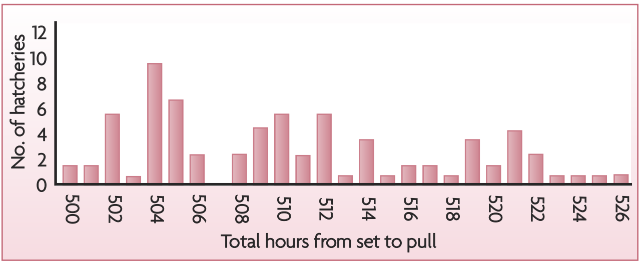
Knowing the correct incubation time from setting to hatching is important for planning optimised chick take-off. For optimal chick quality, pulling should occur when 90-95% of the chicks are completely dry, with 5-10% almost dry except at the neck. Chicks collected at the optimum time point show no signs of dehydration or feather development, while dehydrated chicks are inactive, with thin legs and dry-looking scales.

Advice

To pull chicks at the correct time for optimum chick quality:

- Plan the start of the incubation cycle such that chicks are ready for take off at 504 ± 2 hours. Accommodate variance in hatching times within and between hatcheries.
- Decide on the actual take-off time by observing the hatched chicks at 500 hours. This is especially important when fresh eggs from peak production flocks are incubated.
- Be flexible in choosing the first hatcher to be pulled: trust observation over routine. When 5-10% of the chicks in a tray are still wet around the neck, the hatch is ready for take-off.
- Adjust setting times for subsequent cycles based on continuous observation and data analysis from previous incubation cycles, taking egg type, flock age and storage time into consideration. ■

Fig. 1. Frequency distribution of routine incubation times worldwide (from Laughlin, 2007).



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Formalin free hatching egg disinfection 40

by Gerd de Lange, senior poultry specialist, Pas Reform Academy

Disinfecting hatching eggs is a critical control point (CCP) in the poultry production chain, aimed at reducing the introduction of pathogens into the hatchery for the production of healthy day-old-chicks.

Properly carried out, fumigation with formaldehyde gives excellent disinfection results at relatively low cost – and has become a common method of disinfecting hatching eggs worldwide (see Cadirci (2009) for a detailed review).

However, contra-indications for human health and the environment have already prompted several countries to ban the use of formal-dehyde and, as pressure grows to discontinue its use, more are expected to follow.

However, there are several good alternatives, both for disinfectants and in methods of application.

Applying disinfectant as a gas, as with fumigation, is advantageous because many eggs can be disinfected simultaneously, with the added assurance that the entire surface of each egg is properly treated.

The same quality of disinfection can be achieved by low volume misting, which produces a very fine fog with a maximum droplet size of 10 microns.

Hatcheries employing this method report good results with air supported nozzles, while noting that to achieve even distribution of the disinfectant over eggs that are tightly packed on setter trays loaded in setter trolleys, some fine-tuning of air pressure and the supply pressure and speed of the disinfectant solution is required. Trials are currently underway to find a more robust, less sensitive type of nozzle.

Depending on the type of disinfectant used, between five and ten litres of disinfectant, in solution according to the manufacturers' instructions, is sufficient to disinfect 115,200 eggs loaded on 24 setter trolleys.

Complete disinfection can be achieved in less than one hour, depending on the number of nozzles used, with the further benefit that existing (formalin) fumigation rooms can be adapted to deliver low volume misting without major renovation. With low volume misting, the egg surface becomes slightly wet, which is a good indication that the disinfectant is properly distributed.

While it is true that eggs should not get wet by water, for example rain, humidifiers or condensation, which provides a transport medium for bacteria to enter the egg through pores in the shell, it is a myth that eggs should not get wet when using a suitable disinfectant, which will kill micro-organisms and presents no threat.

Disinfectants containing quaternary ammonium compounds combined with glutaraldehyde and hydrogen peroxide in combination with per-acetic acid have been used successfully for hatching egg disinfection.

Overdosing should be avoided, as this may either cover the pores, which could hamper weight loss and gas exchange during incubation, or damage the protective cuticle.

A further and more recent development is the sustainable, on-site production of a highly effective, non-toxic disinfectant that is known to have no adverse side effects with continued use.

Electrical Chemical Activation (ECA) of a saturated sodium chloride solution, found its origins in the Soviet Space Program several years ago. It has been further developed by the Dutch company Watter BV, such that it now delivers a disinfectant solution in a reliable and repeatable manner.

This disinfectant, which contains active chlorine compounds, different hydroxyls, hydroxyl radicals and oxygen compounds, has been extensively trialled by several Dutch hatcheries, who report excellent results, with the additional benefits of user, material and environmental friendliness. Production costs are extremely low. Whichever route the hatchery chooses, it is clear that formalin-free hatching egg disinfection is achievable in the hatchery.

Advice

- Disinfect shell-clean hatching eggs only.
- Ensure good distribution of the disinfectant over the entire surface of every egg.
- Evaluate the type of disinfectant, dilution rate and quantity not only by reduced numbers of micro-organisms, but also by effects on weight loss during incubation and the effect on cuticula, hatchability and chick quality.
- Consider the effects of the disinfectant on personnel, equipment and your environment over the long term.

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